THE KITIMAT-TERRACE CORRIDOR

AN ANALYSIS OF POTENTIAL INDUSTRIAL DEVELOPMENTS AND ASSOCIATED LAND DEMAND

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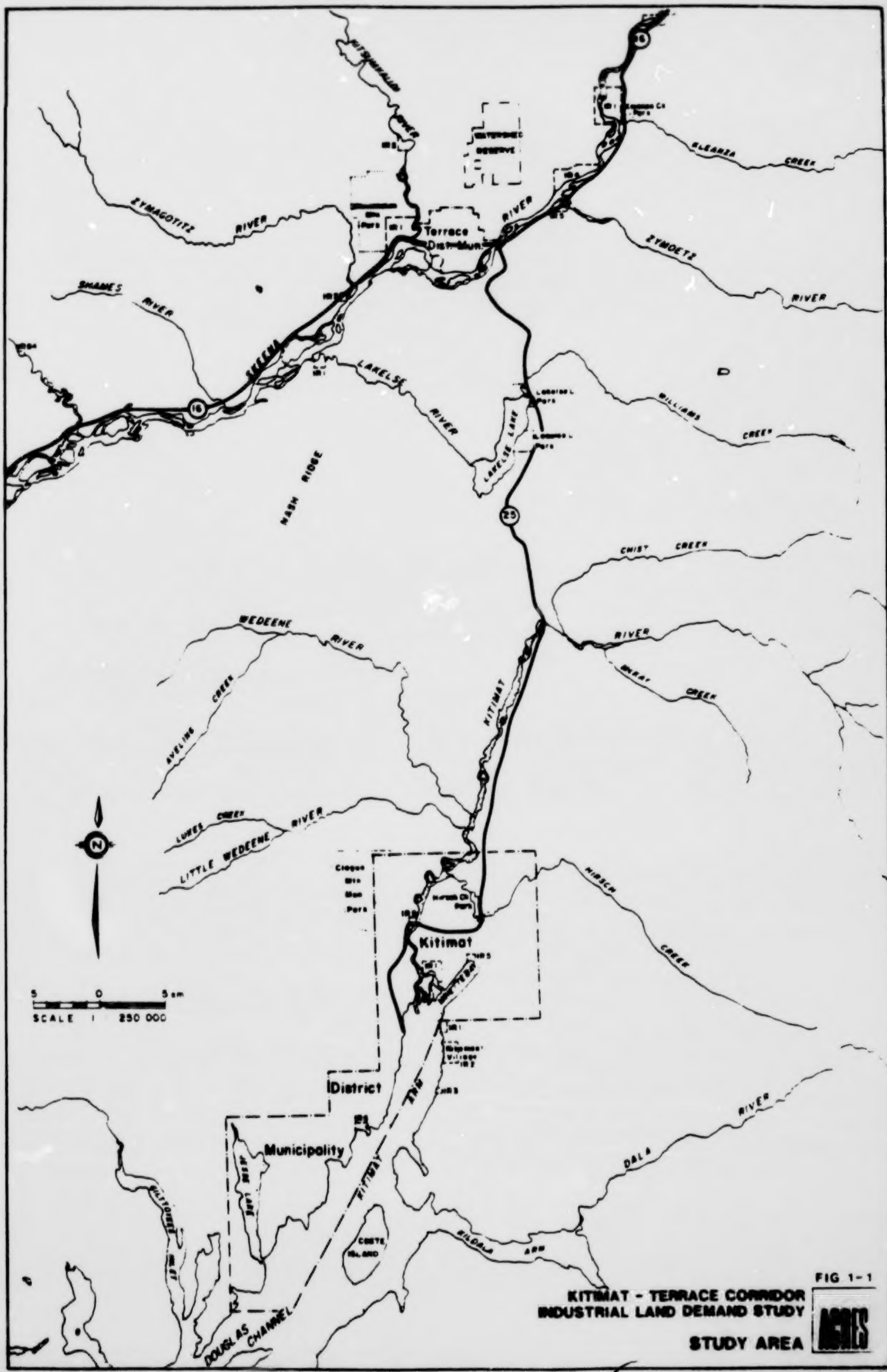
1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

Acres Consulting Services Limited was commissioned by the Ministry of Industry and Small Business Development to prepare a report on industrial land demand in the Kitimat-Terrace Corridor. The purpose of the study was to investigate significant projected land requirements for potential industrial developments in the Corridor over the next 10 and 20 years.

The Kitimat-Terrace Corridor is an approximate 62,000 hectare region bounded by Treston Lake near Terrace to the north, Douglas Channel to the south and rugged peaks of the Kitimat Range on either side (see Figure 1-1).

Compared to other regions at the same latitude, the Corridor has an unusually favourable climate and, consequently, it has significant agricultural and forestry potential. Agricultural Land Reserves cover a large part of the valley bottom. However, little agriculture is currently practiced outside the immediate Terrace area. Most of the Corridor's forest cover has been recently logged. In recognition of its future forestry value, a substantial area has been replanted and a new provincial forest has been proposed for the Central Corridor area. Except for the settled lands around Kitimat and Terrace, most of the Corridor is vacant land. Thus, it represents one of largest tracts of developable land with ocean access on the west coast of North America. Furthermore, the Corridor is strategically located on the Pacific Rim and has railway, pipeline and highway access to central North American export products. Major services such as electric power, natural gas, rail and highways extend the length of the Corridor.



ZYMAGOTITZ RIVER
KITSUMKALUM RIVER
WATERSHED RESERVE
Terrace
Dist. Mun.
RIVER
KLEANZA CREEK
ZYMOETZ RIVER
SHAMES RIVER
SKEENA
16
LAKELSE RIVER
LAKELSE LAKE
WILLIAMS CREEK
NASH RIDGE
25
CHIST CREEK
RIVER
WEDEENE RIVER
AVELING CREEK
KITIMAT
LUKES CREEK
LITTLE WEDEENE RIVER
HIRSCH CREEK
N
Kitimat
5 0 5 km
SCALE 1 : 250 000
District
Municipality
JESSE LAKE
KITIMAT ARM
DALA RIVER
KILDALA ARM
COSTE ISLAND
DOUGLAS CHANNEL

FIG 1-1

KITIMAT - TERRACE CORRIDOR
INDUSTRIAL LAND DEMAND STUDY

STUDY AREA

ACRES

Twenty-one sites suitable for major industrial developments were identified. Together they provide 10,715 ha of land. However, 53.3 percent of this land falls within Indian Reserves, Agricultural Land Reserves (ALR) or the proposed Provincial Forest. If this area is deducted, 5,004 hectares of industrial land remains available. Eleven of the 21 suitable sites have direct water access, four in the Kitimat Harbour area and seven on Douglas Channel. The other ten inland sites are scattered throughout the Corridor. The size of individual sites ranges between 30 and 3,300 ha. Details about each site are provided in Appendix A and Sections 3.2 and 3.3.

Based on extensive interviews within the public and private sectors, eleven potential industrial developments whose land demands exceed one hectare were identified. Between 2,405 and 2,436 ha of land would be required to satisfy all of the projects. The amount of land required by each project varies considerably. Two developments, a steel mill and an aluminum smelter both require 800 ha, while an air separation plant would only require 4 to 8 ha. The specific parcel sizes and services required by each development are described in Section 5.0 and Table 5-1. The eleven developments and their proponent sites, if known, are as follows:

(a) Sawmill - Eurocan Pulp and Paper Co. - possible site just north of Kitimat;

(b) Alluminum Smelter - Aluminum Company of Canada Ltd. (Alcan) - possible location at a site midway between Kitimat and Terrace;

(c) Air Separation Plant - Canadian Liquid Air Inc. - expansion of existing plant near Kitimat, or new plant near a major user, if demand warrants;

(d) Ammonia/Urea Plant - Ocelot Industries Ltd. - land adjacent to methanol plant in Kitimat;

(e) LNG Plant - The RIM GAS consortium - Bish Cove on Douglas Channel;

(f) Oil Pipeline Terminal - Kitimat Pipe Lines Ltd. (terminal and export facility) - docks and storage tanks 2 km west of the Alcan Smelter at Kitimat;

(g) Lead/Zinc Smelter - B.C. Ministry of Industry and Small Business Development conducted feasibility studies - possible location midway between Kitimat and Terrace;

(h) Steel Mill - B.C. government and NKK of Japan - preferred site 6 km north of Kitimat;

(i) Copper Smelter - B.C. Ministry of Industry and Small Business Development - tide water location is preferred;

(j) Coal Slurry Pipeline - Alberta Government and Fluor Canada Ltd. (joint study) - site on Douglas Channel;

(k) Coal Slurry Pipeline - Chieftain Development Co. Ltd. - ongoing studies for alternate coal slurry pipeline.

A probability assessment was conducted to determine the likelihood of potential developments taking place and their timing under three economic conditions: low, medium and high growth. For all industries and scenarios, economic conditions such as market price or size were found to be the most critical determinants of project go-ahead.

Under a low growth scenario, the sawmill project has a probability of occurrence of 46 percent in the 1982 to 1992 period with the next most likely projects being the Ammonia/Urea Plant (30%) and the LNG Plant (19%). The probability of projects occurring between 1993 and 2003 in this scenario is very low, the Alberta Government promoted pipeline had the highest probability of 15 percent. Thus, it is unlikely that more than 881 ha of land would be required over the 20 year period to accommodate all the most likely developments if low growth conditions prevail.

In the medium growth scenario, four projects have a greater than 0.25 probability of occurring within the first decade. These are: the LNG Plant, the Ammonia/Urea Plant, the Coal Slurry Pipeline (Chieftain) and the Sawmill. In addition, three projects have a greater than 0.20 probability of occurring between 1993 and 2003 under the defined medium growth conditions. The aggregate land demand for these seven most likely projects under this scenario is 1,311 hectares.

Finally, under the high growth scenario, five projects have probability exceeding 0.50 between 1983 and 1992, while four projects have a greater than 0.25 probability for the second decade. The aggregate land demand for all nine of these projects over the 20 year period is only 1,319 ha or 12.3 percent of the available land.

Conceptual cost estimates for connecting services to each of the 21 sites were prepared. In all cases, rail service was the most expensive item, generally accounting for 59 percent of the total cost. Road costs were the next highest (28%), then gas linkage (9%) and electricity was least (4%). The seven Douglas Channel sites would be the costliest to service, at over $15 million each. Three sites near Terrace and three in the Kitimat Harbour area are the next most expensive, costing between $2.5 and $10 million each. The cheapest sites to service are those such as the Dubose site (midway in the Corridor) which have rail, power and road access nearby.

Socio-economic and environmental concerns, and/or site-specific engineering analyses may preclude development of some sites. Among the socio-economic concerns preservation of agricultural lands within the ALR and the establishment of a proposed 20,482 ha Provincial Forest are key issues. If potential industrial lands are excluded for these purposes, the amount of residual land available is reduced by over 50 percent. Thus, there would still be 5,004 ha of available land, more than double the 2,436 ha required to satisfy all projected projects.

Several of the potential industries have indicated specific site preferences and land area requirements which, in turn, might be affected by the existing/proposed ALR and Provincial Forest reserves. However, there are alternative options available, such as assembling adjoining sites or dedicating specific land areas for industrial use within these reserves.

Consequently, it is apparent that the Kitimat-Terrace Corridor has a sufficiently large land base to accommodate prospective industrial requirements without jeopardizing the fundamental integrity of traditional forestry and agricultural operations.

2.0 CHARACTERISTICS OF THE KITIMAT-TERRACE CORRIDOR

2.0 CHARACTERISTICS OF THE KITIMAT-TERRACE CORRIDOR

2.1 GEOPHYSICAL FEATURES

2.1.1 Location

The study area is located in northwestern British Columbia. Its most southerly point is approximately 650 km north of Vancouver (or 715 km by water). The boundaries of the study area were defined from south to north as extending from Maitland Island in Douglas Channel (which is slightly south of the Kitimat Harbour Limit) northwards 128 km to a point just south of Treston Lake. The width of the study area was defined by the 300 m contour on the valley hillsides.

The rugged Kitimat Range of the Coastal Mountains attains an average height of 2,000 - 2,500 m along both sides of the Corridor. The Corridor boundaries were chosen with reference to terrain considerations as well as previous studies. The boundaries incorporate Kitimat Arm and the Kitimat Industrial, Utilities and Transportation Corridor (IUTC)[27] as defined in the Regional District of Kitimat-Stikine's planning studies.

The Corridor contains only two incorporated population centers, these being Kitimat and Terrace. Kitimat is located 130 km inland from open water at the head of Douglas Channel, one of the largest deep water fiords on the British Columbia coast. It lies near the mouth of the Kitimat River, at the entrance of the broad, U-shaped Kitimat Valley. The nearest neighbouring city is Terrace, which is located 60 km to the north along the Skeena River. Terrace lies at the junction of road and rail service to Kitimat and Prince Rupert. It is situated 145 km inland from the sea, and has no direct ocean access. Rural unincorporated residential developments in the Terrace area are included within the study boundaries.

2.1.2 Physiography

Situated in the Coastal Mountains, the Corridor is flanked by granitic bedrock on the east side while metamorphosed sedimentary and volcanic rock lie to the north and west. The Corridor is part of a great glacial valley which extends from Douglas Channel, up Kitimat Valley and beyond Kitsumkalum Valley. After the recession of the glacial ice sheets, the valley was submerged by ocean waters up to 183 m deep until post-glacial continental rise caused the present valley to emerge.[20]

The Corridor is relatively wide and flat throughout most of its length. Within it, few construction problems exist which are attributable to topographic constraints except for Sand Hill, (Elev. 183 m), which separates the lowlands west of the harbour from the rest of Kitimat Valley further north. It restricts transportation links through the Corridor, compressing them between the Kitimat River and the eastern toe of the Hill.[34] The Kitimat Valley ranges in width from 10 - 13 km. There are two large flat plateaus in the Corridor, one just south of Lakelse Lake where the Valley widens to 10 km, and a smaller plateau located just south of Terrace on which the airport is situated. These basically represent deposits of sand and gravel which were built up as outwash plains during two stages of glacial stagnation. The Lakelse-Kitsumkalum Valley, extending northwards from Lakelse Lake, maintains this width until it reaches Terrace, where the Valley widens to 19 km between Copper Mountain and Nash Ridge. The Kitsumkalum Valley also retains features similar to those of the Kitimat Valley, such as the steep rocky walls and flat bottom, with occasional rocky outcrops.[27] North of Terrace, the Kitsumkalum Valley becomes much narrower until it is only 4.5 km in width at the study area boundary (see Figure 2-1).

Terrace (100 to 130 m in elevation) is located on benches carved by the Skeena River into the former flood plain. The lower terraces were formed as the plain eroded and new alluvial material was left behind. The lowest bench, below 58 m elevation, represents the current flood plain of the Skeena River.[22]

2.1.3 Climate and Air Quality

The marine dominated climate of the Kitimat-Terrace Corridor is influenced during most seasons by low pressure systems that have moved eastward across the Pacific. These impinge upon the northwest B.C. Coast, particularly in the autumn. The climate is further modified by orographic factors, but still exhibits many characteristics of a continental climate, particularly near Terrace. Kitimat is characterized by an only moderately altered marine climate. The north-south orientation of the valley provides a pathway for seasonal winds. Notwithstanding this, a strong diurnal wind pattern also exists.[1]

Local variations in climate are largely related to topographic features. The climatological characteristics of the two main population centers in the Corridor are summarized in Table 2-1.[1,22]

Current air quality conditions in the Kitimat area indicate that the B.C. government objectives for particulates (a 24 hour average of 260 ug/m^3) are sometimes exceeded. Both the residential and industrial zones meet 'Level A' dustfall objectives (0.93 - 3.97 $mg/dm^2/day$). Although B.C. has as

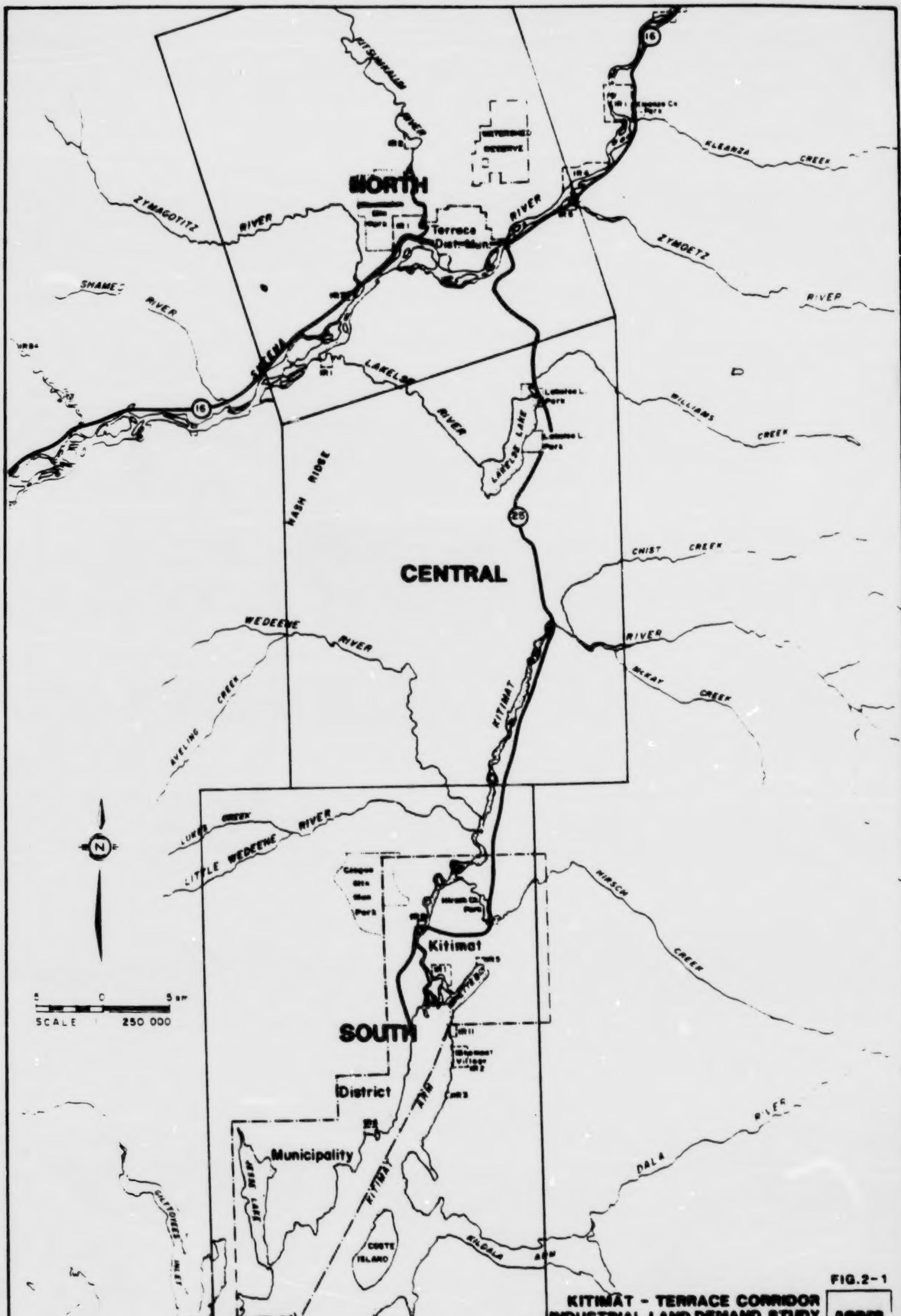

NORTH
CENTRAL
SOUTH
Terrace
District Municipality
Kitimat
District
Municipality
KITSUMKALUM RIVER
ZYMAGOTITZ RIVER
SHAMES RIVER
SKEENA RIVER
KLEANZA CREEK
ZYMOETZ RIVER
LAKELSE RIVER
LAKELSE LAKE
Lakelse L. Park
WILLIAMS CREEK
NASH RIDGE
CHIST CREEK
KITIMAT RIVER
WEDEENE RIVER
AVELING CREEK
McKAY CREEK
LUKES CREEK
LITTLE WEDEENE RIVER
HIRSCH CREEK
Hirsch Cr. Park
KITIMAT ARM
DALA RIVER
KILDALA ARM
COSTE ISLAND
GILTTOYEES INLET
DOUGLAS CHANNEL
16
25
N
5 0 5 km
SCALE 1:250 000

FIG.2-1

KITIMAT - TERRACE CORRIDOR
INDUSTRIAL LAND DEMAND STUDY

KEY TO STUDY AREA MAPS

ACRES

yet no objectives for sulphur emissions, the residential and industrial emissions of 0.19 - 0.03 mg/dm^2/day are well below the Ontario objective of 70 mg/dm^2/day. Sulphur dioxide also falls within 'Level A' objectives, by not exceeding a 0.01 ppm objective on a 24-hour average.[1] The Alcan smelter in Kitimat emits some 3,600 kg of fluoride every 24 hours.[5] It should be noted that there are concerns regarding SO_2 and flouride damage to vegetation in this area, particularly when emission discharge is associated with a high precipitation rate.

In general, the air pollution potential of the Corridor is a product of topographic features and meteorological parameters. Surface-based inversions which contribute to pollution conditions are frequent along the north coast. However, given the combination of strong winds and high precipitation rates, most potential air pollutants could be dispersed or washed out of the atmosphere.[1] It is expected that local episodes of high air pollution concentrations could be anticipated during periods of limited precipitation and light winds.[34]

2.1.4 Hydrology and Water Quality

The Corridor encompasses components of two of northwestern British Columbia's river systems, the Kitimat and the Skeena. The Kitimat River drains an area of 200,000 ha. Only the lower one-third of the system lies within the Corridor, entering at a point just northeast of Iron Mountain (700 m) on the east side of the Valley. The mean annual flow for the Kitimat River ranges from 108 m^3/s to 165 m^3/s.[5] Of the numerous creeks and tributaries, Little Wedeene River is the most significant, with a mean annual flow of 17.2 m^3/s.[37] The Kitimat River flows southward and empties into Kitimat Arm of Douglas Channel.

TABLE 2-1

CLIMATOLOGICAL CHARACTERISTICS OF THE KITIMAT-TERRACE CORRIDOR

Factor	Kitimat*	Terrace**
● Temperature range	-4°C to +16°C	-3.5°C to +21.4°C
● Total precipitation	2400 to 2800 mm	1300 mm (approx.)
● Total hours of sunshine/annum	1410	1427
● Prevailing winds:		
- from the south	Spring, summer & fall 11 km/h	March to November 12-15 km/h
- from the north	Winter 18 km/h	November to March 18 km/h
● Frost-free period	not available	132 days

Sources: * Acres Consulting Services Limited. Environmental Impact Assessment: Kitimat Methanol, Ammonia and Urea Plants. Ocelot Industries Ltd. 1982.

** Kerby, N. Terrace Community Plan, 1980-1990, Analysis and Discussion. District of Terrace, 1979.

Jesse Lake is a potential fresh water source that has an outlet which also flows into Douglas Channel. With a watershed catchment area of 23,300 ha, the lake occupies much of a glaciated U-shaped valley 16 km southwest of Kitimat.[37] Its outlet has an average annual flow of 17.2 m^3/s with a minimum monthly average of 1.2 m^3/s, and a minimum daily flow of 0.96 m^3/s.

The Skeena River drains an area of 5,200,000 ha, and flows east to west through Terrace. The minimum mean monthly flow is 923 m^3/s (recorded at Usk upstream of the Corridor boundary); peak flows occur in the Spring and Fall. Considerable runoff is added to the Skeena below Usk.[19] This would be partially attributable to the inflow from two important tributaries, the Kitsumkalum River and Lakelse River which flow south and north respectively, within the study area.

The Kitsumkalum River drains an area of 2,180 km^2 and enters the Skeena at a point immediately west of Terrace. It has a mean average annual flow of 123 m^3/s.[19]

Lakelse Lake is 10 km south of Terrace. Just south of the lake the elevation rises to 180 m forming a drainage barrier between Lakelse Lake and the Kitimat River watershed. Lakelse Lake is shallow, and has a surface area of 14 km^2, a volume of 108×10^6 m^3, a length of 8.7 km (max.) and a width of 2.4 km (max.). Generally, it is covered with ice four months of the year. It has a drainage area of 31 km^2 with a mean annual discharge of 20 m^3/s.

The lake is fed by 13 small creeks, the chief stream being Williams Creek, and the outlet being Lakelse River.[30,9] One of the principal attractions of the lake is the Skoglund Hot Springs Resort. The Lakelse hot springs, (ranging in temperature from 52°C to 73.5°C) are clear, odourless, tasteless, and have a continuous gas discharge. In 1956, Skoglund's Hot Springs Resort diverted these waters for their own commercial use.[25]

In terms of water quality, previous studies on the Kitimat River found the water to be slightly alkaline (pH=7.2), low in dissolved and suspended solids, with a turbidity of 8.24 J.T.U. (Jefferson Turbidity Units). Water temperatures have tended to be low, and the dissolved oxygen concentration has been near saturation level, averaging 11.65 mg/L. Dissolved sodium values average 8.076 mg/L and total phosphorus content averaged 0.428 mg/L, which are both fairly low levels.[1]

Jesse Lake exhibits a hardness level of 3.57 ppm. Total fixed solids are found at a concentration of 3.9 ppm; total residues at 10 ppm; and turbidity is 3.9 J.T.U.[37]

The Skeena River is generally turbid. Most pollution control parameters (NO_3, PO_4, suspended solids and oil) are below acceptable limits. Only pH and total solids are slightly higher than normal.[19]

Lakelse Lake contains sufficient phosphorus to become eutrophic. However, limiting factors in the form of nitrogen and the high flushing rate (58 day period) mitigate its potential deterioration.[9] Thus, any factor which may affect the level of nitrogen or impede flushing would likely increase eutrophication. Phytoplankton in the lake are representative of those found in oligotrophic conditions. Zooplankton are poor both in number of species and total abundance.[30]

2.1.5 Surficial Geology

The surficial geology of the Corridor reflects its history of glacial depression, marine inundation, and the more recent fluvial processes that have contributed the materials presently occupying this wide valley.

In the Kitimat area, unconsolidated sediments, such as marine silts, clays, and gleysols are generally found. Marine clay deposits extend on the west side of Kitimat Arm as far south as Emsley Cove.[19] The surficial materials north of Kitimat Arm and in the Lakelse Lake area, and the Kitsumkalum Valley, consist of recent deposits of nearly horizontal strata of alluvial sand, gravel, marine and glacio-marine clays. These occur up to an elevation of 300 m.[9,34] The Skeena River Valley consists of glacial till, outwash, and glacial lacustrine deposits. Post-glacial runoff contributed to the development of alluvial deposits along streams. These consist of variable, often stratified, sorted gravel, sand, silt, and clay.

In general, there is no shortage of local construction materials available. In the intertidal delta, potential development sites could be built up using dredged material recovered from the construction of channels and basins. Another source of material, locally known as Sandhill, has an estimated 15,300,000 m^3 of sand and gravel available within 7 km of the estuary. Quarried rock supplies from the several small rock quarries located on the east side of Minette Bay are relatively abundant.[34]

Most of the soils in the Corridor are glacio-fluvial in origin, and occur on the terraces, pans, and floodplains of the major rivers and their tributaries. Organic deposits occupy low-lying, poorly drained depressions associated with the shorelines of lakes and ponds, particularly southwest of the Lakelse area.[11,31] However, podzols, generally associated with heavy rainfall and a long, cool growing season, are the dominant soil type. They are suitable for supporting numerous forest tree species.[5]

2.1.6 Terrain Hazards

Construction constraints due to soil and terrain conditions are evident in localized areas. On the west side of Kitimat Arm, near Emsley Cove, the presence of weak marine clay deposits, and the associated risk of mass wasting was a factor in rejecting this area as a possible site for industrial development in the past. Slope failures have taken place both above and below sea level. For example, in 1975, a large underwater slide, which displaced 2.3 million m^3 of material, occurred just south of Kitimat generating a seawave of 7.6 m.

The lower 100 m bordering the steep mountain slopes between Alcan's facilities and Emsley Cove consists of similar unstable marine clays and poses a potential problem for the construction of access routes.[34] As the Corridor is located in Seismic Zones 2 and 3,[26] there is a moderate risk of seismic activity. Thus, there exists the potential of damage due to liquefaction of the substrata. This may occur during earthquakes in areas having saturated soils or high water tables.

However, most of the Kitimat-Terrace Corridor is well-drained and suitable for construction provided that the water table is not too high. In the lower valleys, major developments would as a matter of prudence, need to be constructed to withstand a 200-year flood.

In the Terrace region, there are also a few localized areas of concern with regard to potential construction activity. Along the northeast edge of the Municipality of Terrace, localized clay deposits over bedrock render this area generally unsuitable for major development. In the northwest corner of Terrace, localized silt and sand deposits would require special consideration during construction.

Similarly, the alluvial silt and humus deposits along the Skeena River may require special construction methods. The steep escarpments along the Kitsumkalum River are also composed in part of unstable clays. To date, no development other than gravel removal has taken place along the river.[22]

The risks of snow avalanches or rock/mud slides is limited to the edge of the steep walls of the Corridor. In 1962, the Lakelse slides blocked a portion of the highway near Lakelse. However, in general the occurrence of slides are not considered as key constraints to development elsewhere in the Valley.

2.2 BIOLOGICAL FEATURES

2.2.1 Vegetation

The Corridor lies in the wet coastal western hemlock (CWH) biogeoclimatic zone. This zone is suitable for high production of such conifers as western red cedar, Sitka spruce, western hemlock and Amabilis fir. Northwestern B.C.'s forests are mainly characterized by mature and over mature stands of hemlock and balsam with some spruce and lodgepole pine.[5] Although most of the Valley is presently clear cut, strategically located buffer stands remain. In the last 15-20 years, approximately 4.4 million trees have been planted at a cost of $1.6 million.[15]

The Kitimat Valley is particularly suitable in terms of soils and climate for forest growth. Rotation age for good sites in the Kitimat valley is 60 years as compared to good sites in T.F.L. #41 (Eurocan) at 65 years, or T.F.L. #1 (B.C. Timber) at 70 years. The productivity of timber from the Kitimat Valley at 798 m^3/ha is higher than the 735 m^3/ha found in the Skeena River Valley. In contrast, Eurocan's best site near the Valley yields 686 m^3/ha.[16] The timberline in the Corridor is found at about 1,200 m elevation.[9]

In general, along the banks of the Kitimat and Skeena Rivers and their tributaries, the alluvial flood plain forest is dominated by northern black cottonwood and red alder. Most of the Valley bottom has a lowland coniferous cover of western cedar and western hemlock. This is interspersed with localized conifer/deciduous bogs.[5] The vegetation around Lakelse Lake consists mainly of hemlock and spruce with lesser amounts of cedar, balsam, pine, cottonwood and alder.[19] Near Terrace the CWH zone is strongly influenced by interior species and has some similarity to the the Sub-Boreal Spruce (SBS) zone. Areas of regrowth support lodgepole pine, aspen, birch, alder and also some hemlock and spruce.[22]

The Kitimat estuary is dominated by intertidal reeds, sedges and grasses. The predominant arrowgrass marsh is important to wildlife. For fisheries, the lower salt marsh provides food for juvenile salmonids and spawning areas for herring. For ungulates, suitable winter habitat is available in the upper freshwater marsh. Both the upper and lower marsh are conducive to waterfowl habitation.[1] In particular, the salt water marsh is an area of great concern as it provides prime avian habitat. In the Hay report (1976), the area east of the harbour was identified as a potential, high quality waterfowl reserve.[18]

2.2.2 Mammals

Only limited recent data is available regarding resident and seasonal mammalian populations within the study region. However, in the Corridor and Kitimat Arm area, the presence and abundance of key terrestrial and marine mammals have been documented in previous studies, reports for government wildlife management personnel, and sightings by local residents.

The Valley has been extensively logged. As a result, the best wildlife habitat occurs along the edges of the remaining forest buffer zones, and along foreshores and lakes where habitat variability is increased.

Only a few species of large mammals occur. Of the ungulates, moose and deer are found in the low elevation Kitimat Valley. In general, the Corridor has moderately severe (Class 5) to moderate (Class 4) limitations to ungulate production. Climatic conditions, a combination of high snowfall and short growing season, limit the growth of plant species suitable for forage. Lack of forest shelter and the restriction of winter movement by snow drifts further discourages ungulate populations.[7]

In the Kitimat estuary area, a group of 6 to 7 Sitka deer migrate diurnally and seasonally from the adjacent highlands to the tidal flats. The flats are also used as a wintering ground by both Sitka deer and moose. Moose are frequently seen feeding along the Kitimat River.[1]

Between Kitimat and Lakelse Lake, few ungulates are sighted due to severe conditions and hunting pressures. However, north of Lakelse Lake, moose frequent the adjacent lowlands. Sitka deer are commonly found around Terrace and in the Kitsumkalum watershed to the north of the Town (Class 4 capability).[22] Numerous black bears migrate and forage throughout the Corridor. The frequency of sightings has increased as bears seek out potential food sources at local garbage sites. However, only the occasional bear winters or dens in the Valley.

Small mammal species are present in greater diversity. Along the Kitimat River, transient riparian furbearers, such as mink, marten, otter, fisher and red fox are found. In the wetland areas surrounding Lakelse Lake, American beaver and muskrat are abundant. Throughout the Corridor, human-tolerant species, including the American porcupine, striped skunk, vagrant shrew, red squirrel and white-footed mouse are common. Carnivores which frequent the Corridor as part of their wider range, include the coyote, wolf, and the relatively rare wolverine.[1]

Sea mammals in Kitimat Arm are usually sighted during the spring eulachon or salmon runs. They include sea lions, harbour seals and killer whales, with occasional sightings of rarer pinipeds, such as the elephant seal, northern fur seal and the California sea lion.[1,14]

2.2.3 Birds

The study region is only moderately important in terms of overall avifaunal habitat. In general, the greatest numbers and diversity of bird species are concentrated in the lowland deciduous bogs and in the arrowgrass salt marshes of the Estuary.

The Kitimat Estuary is important for migrating and wintering waterfowl, but it is not particularly suitable for waterfowl production (Class 3, B.C. Land Inventory). Waterfowl are present year round and their numbers increase in winter and spring. The tidal amplitude of 4.2 m helps to ensure an available food supply year round. Dabbling ducks, geese, swans and brants are usually found in the Central Delta and Minette Bay. Diving ducks are most commonly found in Minette Bay Channel and also in the Central Delta. Marsh birds and shore birds are only abundant during the spring and fall migrations, particularly in the Central Delta. Of all avian genera utilizing the estuary, gulls are the most abundant in number. Groups of diving birds sighted include alcid species, cormorants, grebes and loons.

Of the raptors, the bald eagle is most numerous, particularly along the estuary foreshore. Goshawk, sharp-shinned, red-tailed, and marsh hawks, the American kestrel and pygmy owls have been sighted, as well as the peregrine falcon.

Representatives of the upland game birds include the blue and ruffed grouse, band-tailed pigeon, rock-dove and mourning dove. Other upland birds frequenting the productive estuarine habitat include the common raven, northwest crow and Stellar's jay.[1]

In total, the estuary supports some 165 different bird species, of which 84 are breeding species. The tidal flats east of the Eurocan dock support the greatest diversity with 99 species, closely followed by the favourable habitat of the cottonwood-alder floodplain along the Kitimat River and its tributaries (83 species). The tidal flats have been recommended as a suitable location for a waterfowl reserve to protect avian habitat.[18] As well, the buffer zone along the Kitimat River helps to ensure a travel route for avifauna.

To the north, Lakelse Lake and other small lakes in the Lakelse watershed are also used as a migration, staging and wintering area by waterfowl and shorebirds. Trumpeter swans are common migrants, and some individuals may be nesting north of Terrace.[35]

In Terrace, only the cosmopolitan songbirds are numerous, although larger flocks of waterfowl such as Canada geese occasionally frequent the fields located on the benches along the north side of the Skeena River. However, only about

30 species of waterfowl are found in the Skeena River area.[19] As no endangered species are found within the Corridor, and annual bird migrations do not involve large numbers of birds moving into or through the area during any particular time period, the recreational value of the avifauna as a natural resource is not particularly high.[18]

2.2.4 Aquatic Resources

From a biological point of view, an important characteristic of the Kitimat estuary is that it is physically smaller than most others on the B.C. Coast. In general, it exhibits a low species diversity in the intertidal and shallow subtidal zones. However, it is important biologically since the high intertidal area, composed of a substrate of sand and silt stabilized by marsh grasses, is the preferred feeding habitat for juvenile salmon.[1]

The Kitimat River supports a large anadromous fish population which has an annual average escapement of 200,000 individuals. Steelhead, coastal cutthroat trout, and Dolly Varden are the most abundant resident species. All five Pacific salmon, coho, chum, chinook, pink and sockeye, occur in the Kitimat River (see Table 2-2). Of these, only sockeye salmon have declined, partially due to the lack of lakes in the Kitimat River system. Of the marine species found in upper Kitimat Arm, the most important are the eulachon, capelin and small stocks of herring. Herring, which are resident stock and have a slow growing population, do not produce roe of commercial significance. Groundfish include ling and grey cod, rockfish, halibut, sole and flounder.[5]

The Kitimat River is popular for sport fishing, and accounts for 60% of the local annual sport fishing effort. In 1974,

TABLE 2-2
PACIFIC SALMON - FISHERIES RESOURCE IN MAJOR RIVERS OF THE KITIMAT-TERRACE CORRIDOR

SOURCE	SALMON SPECIES				
	Pink	Sockeye	Chinook	Coho	Chum
Skeena River** (Average annual escapement)	1,086,000	648,000	22,700	72,000	16,077
Lakelse Lake*** (Average annual escapement)	607,000	13,000	2,000	26,000	100-300
Kitimat River****					
1970-1980 (catch)	71,800*	920	4,050	7,050	23,100
Indian food fishery	340	140	300	390	920

* Pink Salmon do not spawn in Kitimat River

Source: ** Sinclair, W.F. The Socio-economic Importance of Maintaining the Quality of Recreational Resources in Northern British Columbia: The Case of Lakelse Lake. Jointly published by the Fisheries and Marine Service and the Kitimat-Stikine Regional District, 1974.

*** Spawning in Lakelse Lake, files from Regional District of Kitimat-Stikine, 1980.

**** Acres Consulting Services Ltd., Environmental Impact Assessment, Kitimat Methanol Ammonia and Urea Plants, Volume One. Ocelot Industries Ltd., 1982.

it provided 104,000 angler days serving largely local fishermen.[30] The Kitimat River is also an Indian food fishery resource, see Table 2-2.

A viable recreational crab fishery exists in Kitimat Arm. Records show that up to 15,000 crabs have been caught in an expenditure of 5,000 fisherman-days.[25] There is no significant commercial fishing for demersal fish species.[5] Douglas Channel, from Money Point northwestward, is permanently closed to commercial fishing.[8]

The Skeena River is one of the top steelhead producing rivers in the Province. Other resident freshwater species of significance include lake trout, burbot, Dolly Varden, rainbow trout, and Eastern and Rocky Mountain Whitefish. All five Pacific salmon species spawn in the Skeena and its tributaries. The Skeena Estuary is also an important area for production of marine species, and it is the major producer of rock sole in Canada. Other marine species of importance include English sole, Pacific cod, and Pacific herring.

The streams and lakes of the lower Skeena provide an important sports fishery resource. Although not affecting Terrace, there is a commercial fishery for salmon and halibut in Prince Rupert which depends upon the continued quality of the Skeena River for its resource base. As well, the Skeena supports an Indian food fishery resource. A report prepared in 1975 by Johnston Associates Management Ltd. indicated the food fishery included: sockeye, coho, pink, chum, and chinook salmon and steelhead with a total average catch of 520,000 kg annually.[19]

Lakelse Lake is also important for its fisheries resource. Seventy percent of the total pink salmon production of the

Skeena River originates from the Lakelse watershed.[28] Lakelse Lake provides mainly a recreational fishery, and its tributaries support valuable spawning habitat.

2.3 UTILITIES AND TRANSPORTATION INFRASTRUCTURE

2.3.1 Road Network

The Corridor is serviced by two main highways. From east to west, the transprovincial or Yellowhead Highway No. 16 extends from Winnipeg to Prince Rupert passing through Terrace. Running north to south, Highway No. 25 links Terrace to Kitimat (see Figures 2-2, 2-3, and 2-4).

Generally, Highway No. 16 is a high-standard, two-lane paved road. However, the 150 km section between Terrace and Prince Rupert is rated very hazardous under adverse weather conditions due to danger from floods, avalanches, snow and ice. A minimum annual maintenance cost of $1 million (1982 dollars) is required to keep this particular portion passable.[21]

In the last five year period, 1977-82, over $40 million has been spent on upgrading and maintenance of Highway No. 16. It is anticipated that further upgrading and relocation of sections of the road will be required to reduce the risk from natural hazards, particularly avalanches.[21]

Highway No. 25 is also a high-standard two-lane, paved, all weather road which extends 58 km from Terrace to Kitimat. It is open year round. At present, the highway capacity is adequate for current traffic volumes and for predicted volumes expected over the next decade. The present annual maintenance cost is approximately $300,000 (1982 dollars).

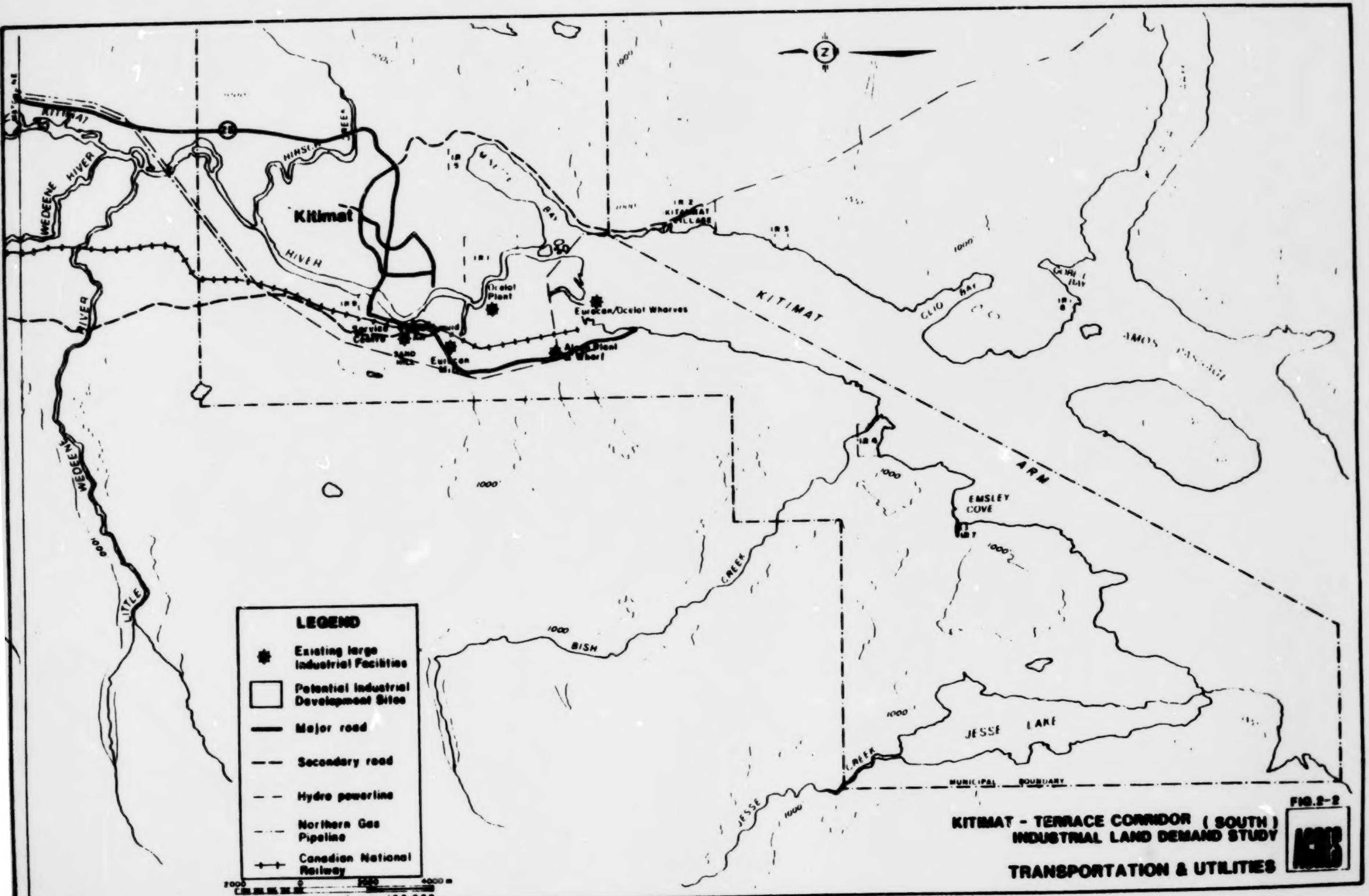

N
Kitimat
KITIMAT
HIRSCH CREEK
KITIMAT RIVER
WEDEENE RIVER
LITTLE WEDEENE RIVER
Service Centre
Sand Hill
Eurocan Mill
Ocelot Plant
Eurocan/Ocelot Wharves
Alcan Plant Wharf
MINETTE BAY
KITAMAAT VILLAGE
I.R. 2
I.R. 5
I.R. 1
I.R. 6
KITIMAT ARM
CLIO BAY
GOBLE BAY
AMOS PASSAGE
EMSLEY COVE
BISH CREEK
JESSE CREEK
JESSE LAKE
MUNICIPAL BOUNDARY
1000
LEGEND
Existing large Industrial Facilities
Potential Industrial Development Sites
Major road
Secondary road
Hydro powerline
Northern Gas Pipeline
Canadian National Railway
2000 0 2000 4000 m
SCALE 1 : 100 000
ACRES

FIG.2-2

KITIMAT - TERRACE CORRIDOR (SOUTH)
INDUSTRIAL LAND DEMAND STUDY

TRANSPORTATION & UTILITIES

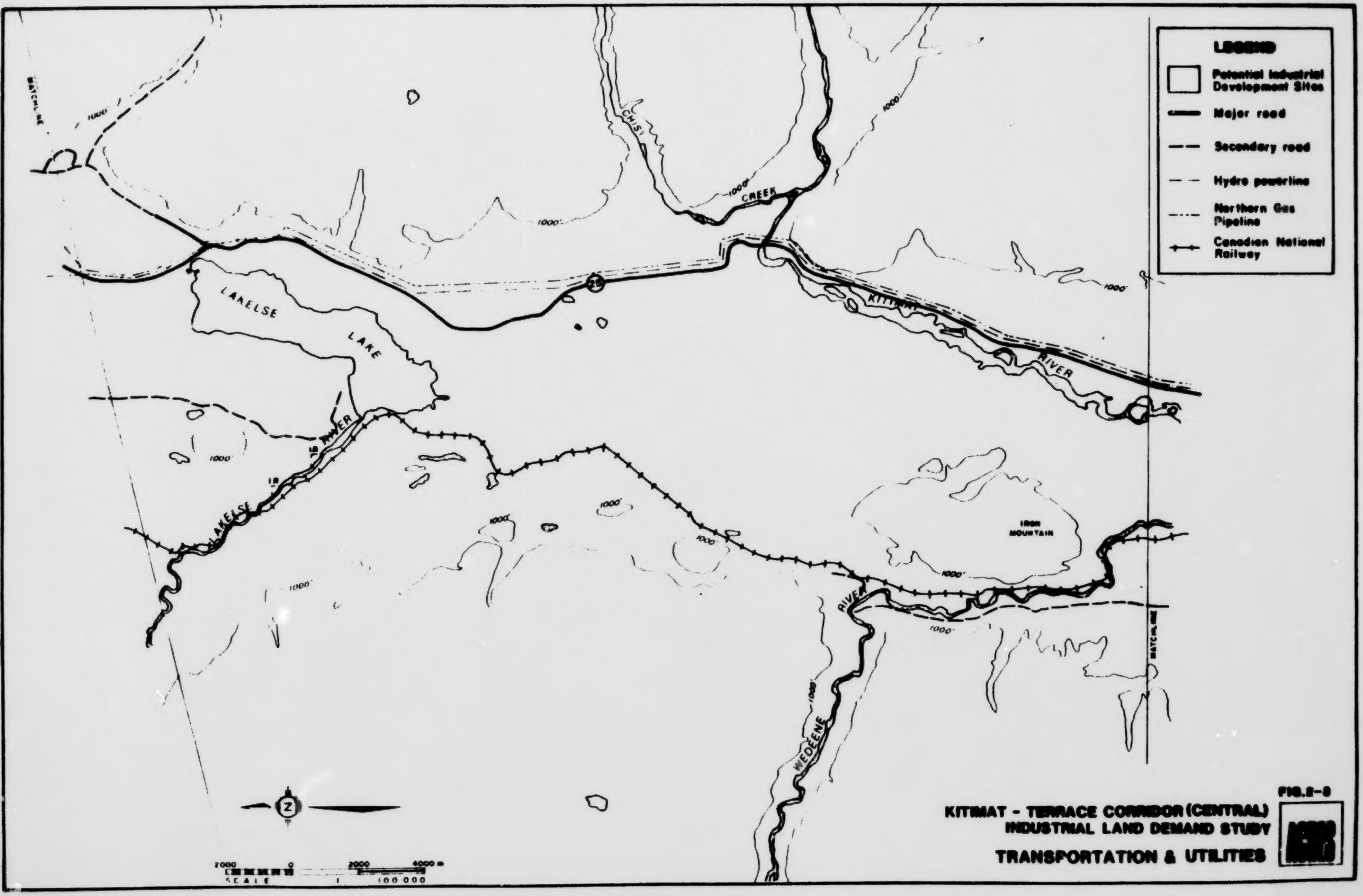

LEGEND
Potential Industrial Development Sites
Major road
Secondary road
Hydro powerline
Northern Gas Pipeline
Canadian National Railway
MATCHLINE
CHISI CREEK
KITIMAT RIVER
LAKELSE LAKE
LAKELSE RIVER
IRON MOUNTAIN
WEDEENE RIVER
1000'
25
Z
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.2-8

KITIMAT - TERRACE CORRIDOR (CENTRAL)
INDUSTRIAL LAND DEMAND STUDY

TRANSPORTATION & UTILITIES

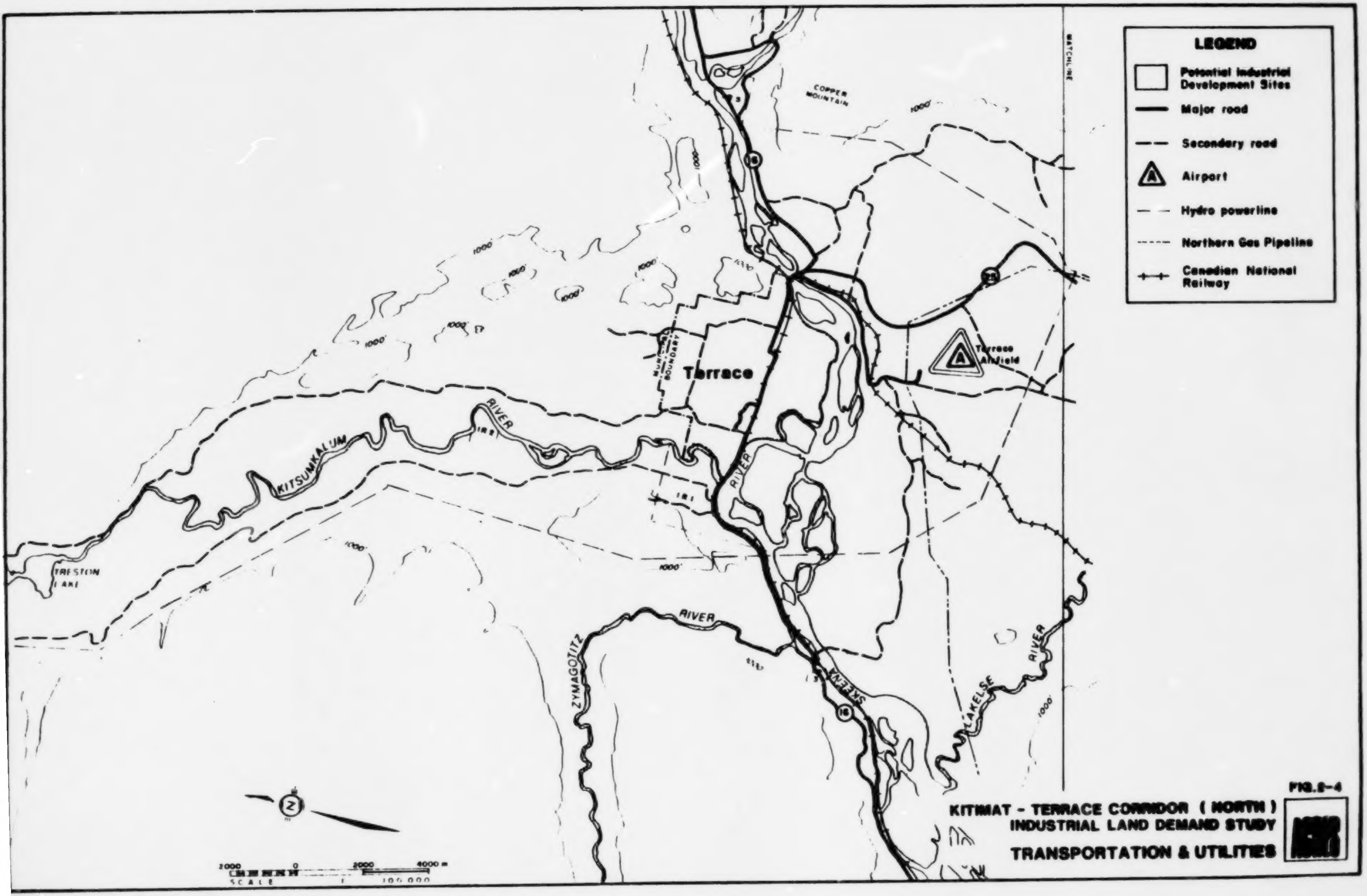

LEGEND
Potential Industrial Development Sites
Major road
Secondary road
Airport
Hydro powerline
Northern Gas Pipeline
Canadian National Railway
WATCHLINE
COPPER MOUNTAIN
Terrace
MUNICIPAL BOUNDARY
Terrace Airfield
16
25
KITSUMKALUM RIVER
SKEENA RIVER
ZYMAGOTITZ RIVER
LAKELSE RIVER
TRESTON LAKE
I.R. 1
1000'
N
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG. 2-4

KITIMAT - TERRACE CORRIDOR (NORTH)
INDUSTRIAL LAND DEMAND STUDY
TRANSPORTATION & UTILITIES

If necessary, Highway No. 25 could be upgraded to handle additional traffic created by projected industrial developments at Kitimat.[21] Highway No. 25 has also been incorporated into the Northwest Corridor, or future "Highway No. 37", proposed by the Regional District of Kitimat-Stikine. This highway would provide a valuable link to the Northwest, extending 800 km from Kitimat to Watson Lake, Yukon.[34]

Local roads were identified by the Regional District for their significance as links between proposed industrial development sites and the Industrial, Utilities and Transportation Corridor (IUTC). Road access exists for the east and west harbour areas in Kitimat. This access is also suitable for future rail and public access. On the east side of Kitimat Arm, Minette Bay Road links Kitimaat Village to Kitimat. To the north of Kitimat, the Haisla Bridge links the Townsite to the IUTC.

Several future transportation improvements have been suggested by various levels of government to facilitate industrial development. These included:

- the construction of a 48 km highway connecting Kemano and Kitimat to provide the necessary road to encourage development of a major known copper deposit;
- an extension of the industrial road to the west side of Kitimat Arm to service the Emsley Cove, Bish Creek and Miskatla Inlet areas;
- a future industrial road, bridge and public access that would connect the Wedeene Region, the IUTC and Highway No. 25;

- a further improvement that would entail a future Quatsino bridge, which could provide access from the Kitimat neighbourhoods, such as Kildala, directly to the Kitimat IUTC;[27] and,

- completion of the road on the west side of the Corridor from the existing extension north of Kitimat, along the proposed connection route through to Terrace.

Transportation services in Terrace and Kitimat which use the existing road network include trucking and bus lines. Both municipalities are serviced by major trucking firms. In addition to these, there are seven local cartage and storage firms. Farwest Bus Lines serves both Kitimat and Terrace as a local service within Northwest B.C. Coachways Systems Ltd. (Greyhound) provide an east-west connection twice daily with buses travelling between Prince Rupert and Prince George.[22]

2.3.2 Rail Lines

The main CNR line from Edmonton to Prince Rupert passes through Terrace and provides passenger and freight service. This Prince George to Prince Rupert section is to be upgraded at a total cost of $150 million ($12 million in 1981), in anticipation of the increased freight load resulting from the new grain and coal terminals on Ridley Island. Improvements will include the rebuilding of bridges, as well as strengthening of the track structure and replacement of old steel rails with new 63 kg steel. Previously proposed improvements to the CNR facilities in Terrace have included a potential marshalling yard, possibly located near Copper City Flats, east of Terrace. However, to date no development has taken place.[22] A site south of Terrace has also been identified as a possible maintenance yard for unit trains carrying coal to Prince Rupert.[22]

The existing 62 km CNR branchline between Kitimat and Terrace was built in 1954 at a cost of $10 million (see Figures 2-2 through 2-4). Located on the steep slopes of the Kitimat-Terrace valley, it includes five steel bridges, many wooden spans and a number of major trestles. The original design life was 25 years. At present, it takes three hours to traverse the route as the top speed is limited to 25 km/h and slower in some places. However, this freight route is not seriously hampered by snow or slides, and is accessible all year round.[21]

The capacity of this track is limited to a train with a trailing weight (weight of cars, their contents and caboose) of no more than 3,450 t. No locomotive above 1750 hp can be used and the maximum car weight is limited to 100,000 kg as compared to a main line standard car weight of 122,000 kg.

In 1976, the Kitimat-Terrace branchline handled 1.7 million gross tonnes and by 1981, 2.1 million gross tonnes. On average, 9 trains move per week in each direction, and without upgrading, the branchline could handle up to 21 train movements per week. However, if significantly greater traffic volumes are to move over this route, the track would require upgrading and relocation. CNR has relaid the northern 30 km of the route with 45 kg steel rails, and replacement steel rails lie along the rest of the branch line. To upgrade the remainder of the existing line to take heavyweight cars and handle an annual freight capacity of 10 million t, would cost $58 million. Reconstruction of a new alignment with a capacity of 20 million tons to facilitate unit train operations would cost $100 million (1981). To date, funds for these improvements to the CNR branchline have not been committed.[36]

Additional potential future improvements to the existing rail service to facilitate industrial development include:

- possible location of marshalling facilities for CN trains north of the Kitimat Service Centre;
- improved rail facilities consisting of a run-around track plus spur trackage and/or loop tracks for unit trains to serve bulk facilities;
- some adjustment to road and rail schemes to provide separation essential to maintaining traffic flows;
- a CNR extension south to provide future rail access to the Emsley, Bish and Miskatla areas; and,
- a proposed CNR extension to the north linking Northwest B.C. and the Yukon to Kitimat.[34,27]

2.3.3 Port Facilities and Use

Terrace has access to port facilities in Prince Rupert and Kitimat. However, Kitimat is the preferred harbour facility. Kitimat Harbour, with 16 km of useable waterfront, is a locally run port with primarily private facilities.[8]

Kitimat harbour is accessible through two marine routes and has minimum channel widths for large vessels as follows: 804 m in Principe Channel; 724 m in Laredo Channel; and 1850 m in Douglas Channel. Douglas Channel is one of the widest fiords along B.C.'s north coast. The depth of Douglas Channel varies between 180 - 360 m through most of its length. The width and depth make it navigable for most ocean going vessels.[34] This is more than adequate to handle ships up to 300,000 DWT. A manoeuvering width of 1,200 m at the head of Kitimat Arm is also adequate for most marine operations, considering the low current velocities and relatively stable wind directions characteristic of the Arm.[10]

At present there are three fully operating deep sea docks, those of Alcan Smelters and Chemicals Ltd., Eurocan Pulp and Paper Co. Ltd. and Ocelot Industries Ltd. The total area enclosed by harbour development is 1.4 km^2 while the total original intertidal area of the delta and Minette Bay was 9.1 km^2.[1]

The Alcan terminal, which was opened in 1952, is 229 m long and has a 10 m draught at low tide. It is mainly used for importing raw materials (630,000 t/yr incoming mainly from Australia) and exporting aluminum ingots to Far East destinations. The present water depths and concrete caisson construction of the wharf will allow the berth to accept vessels up to 40,000 DWT. Facilities include a crane and vacuum unloaders which discharge into a belt conveyor which, in turn, transports incoming raw materials to storage facilities. There is rail access to the site. The wharf is capable of handling one deep sea vessel at a time, and over the year handles a total of approximately 65 deep sea vessels. The capacity of the terminal with its existing physical makeup and handling systems is estimated at 900,000 t/yr. No plans for the expansion of terminal capacity have been made public. These would be contingent upon increases in Alcan's plant output.[2,5]

The Eurocan terminal, which opened in 1970, is 137 m long with a 18.5 m berthing depth at low tide. It is used for exporting forest products and offers facilities including a barge ramp and a log load out crane. A 15,000 m^2 warehouse is located on the site. There is no rail access, only an all weather road. Approximately 37 vessels are handled per annum varying from 10,000 to 38,000 DWT.[34] The terminal will only accommodate one deepsea vessel at a time. If expanded, the wharf could accommodate roughly 60 vessels per annum. However, no plans for increasing terminal facilities have been made public.[2]

The Ocelot wharf will be used for the export of methanol. The facilities are suitable for handling 10,000 to 40,000 DWT vessels.[1]

Additional marine services are provided by Rivtow Straits Ltd. which offers local freight and passenger service from a barge terminal accessible from Kitimat.[14] As well, there are federal government wharf facilities at Kitamaat Village. Other local activities requiring marine access include two marinas, MK Bay Marina and Minette Bay Marina, as well as two log booming and storage bases for Eurocan Pulp and Paper Company Ltd., Crown Zellerbach Canada Ltd. and MacMillan Bloedel.[34]

The pattern and density of marine traffic in Kitimat Arm in the form of deepsea and ocean going vessels is summarized in Table 2-3.

Based on historic trends and several industry-related assumptions, traffic projections were calculated for future marine traffic (see Table 2-4). At some future date, it may be useful to assess those factors which may contribute to "bunching", where several vessels are moving in the same vicinity at the same time.

In addition to the data in Table 2-4, there are approximately 400 sailing or recreation boats moored in Kitimat Arm. Their use is both seasonal and generally limited to a range of 55 to 90 km from Kitimat Harbour.[1]

TABLE 2-3
MARINE TRAFFIC DENSITY

Type of Movement	Route Segment	
	Douglas Channel	Kitimat Arm*
Deep Sea: 1974-75	110	206
1975-76	152	290
1980	120	224
Coastal: 1974-75	78	514
1975-76	92	440
1980	42	184

* Deepsea ships arriving at Kitimat generally enter Hecate Strait via Queen Charlotte Sound and enter the inland water network through Campania Sound. They usually depart for Vancouver via the Inside Passage. A substantial part of the coastal traffic occurs between Kitimat and Vancouver. Such traffic, both deepsea and coastal vessels, travel via Devastation Channel and do not use Douglas Channel.

Source: Captain G.A. Veres and Associates Limited. Petrochemical Terminal at Kitimat, B.C.Ocelot Industries Limited, 1981.

TABLE 2-4
MARINE TRAFFIC PROJECTIONS (1985)

Type of Movement	Route Segment	
	Douglas Channel	Kitimat Arm*
Deepsea Traffic - Alcan/Eurocan	120	224
Coastal Movements	110	526
OIL* Methanol	17	17
Total movements per annum	247	767
Average movements per diem	0.7	2.1

Source: Captain G.A. Veres and Associates Limited. Petrochemical Terminal at Kitimat, B.C. Ocelot Industries Ltd., 1981.

* Ocelot Industries Ltd.

In summary then, Kitimat Arm offers high quality harbour access capable of sustaining increases in marine traffic densities, as well as port facilities capable of sustaining increases in cargo through-put. However, this assumes that any future industries wishing to use the existing port facilities can enter into leasing agreements with current owner/operators.

2.3.4 Airports and Air Flight Patterns

The Kitimat-Terrace area is serviced by a federally-operated airport located 13 km southeast of Terrace by road. Constructed as a military airport during World War II, this is the only major airport in the area. There are sea plane facilities at Lakelse Lake.[22] As well, the Kitimat Flying Club has its own airstrip located 16 km north of Kitimat parallel to Highway 25.

The Terrace Airport has three runways, ranging in length from 1,000 m to 1,890 m, which are capable of handling planes as large as a Boeing 727.[22] Each possesses a runway lighting system. The airport is equipped with an instrument landing system which allows landings and take-offs in adverse weather conditions.[32] Instrument assistance also includes four radio beacons. The airport provides weather advisory services and pilot training programs. Passenger facilities have recently been expanded.[22] Aircraft hangars and repair and maintenance facilities are also available.[32]

Commercial air services include daily CP Air and Pacific Western flights with jet passenger and freight service to Prince Rupert, Smithers and Vancouver. Other local air services out of Terrace Airport are available from Terrace

Air Ltd., Okanagan Helicopters Ltd., Northern Mountain Helicopters, and Pine Tree Aviation.[32] Trans-Provincial Airlines offer connections to such outlying areas as Bob Quinn Lake, Iskut, Schaft Creek, Galore Creek, Telegraph Creek and Dease Lake.

Presently, there are two key aspects or patterns of aviation activity. These are:

- aircraft moving within, to and from the region from surrounding flightpaths following Highway No. 16; and,
- aircraft using the Highway 37 Flightpath to the Yukon and Alaska.

Visual flight rules are in effect as aircraft follow Highway No. 37 northwards.[32]

2.3.5 Oil and Gas Pipelines

Present natural gas requirements in the Corridor are supplied by Pacific Northern Gas Ltd. The existing pipeline system includes an 8" line to Prince Rupert, a 6" line to Kitimat and a new 10" line, which was recently upgraded at a cost of $42 million, to the Ocelot methanol plant in Kitimat (see Figures 2-2 through 2-4). At present, these provide a capacity of 2.5 Mm^3/day or approximately 0.9 Bm^3/year.[17] A new compressor (R-5 station) was also constructed near Terrace and can be activated, as necessary.[13]

A comparative breakdown of natural gas consumption can be extrapolated from previous records. During 1980-81 the natural gas pipeline had a daily capacity of 0.5 Bm^3/year with total sales of 0.3 Bm^3/year. The major customers were Canadian Cellulose Ltd. (B.C. Timber), Eurocan and Alcan which used 64% of the total consumed load. Residential, commercial and other industrial consumers in 11 communities along Highway 16 utilized the remaining 36%. Thus, 1980 consumption was approximately 60% of the total 1980-81 capacity. However, given the increased pipeline capacity to approximately 0.9 Bm^3/year, the combination of 1980-81 sales (0.3 Bm^3/year) plus the Ocelot demand of 0.37 Bm^3/year still allows for a 0.23 Bm^3/year of surplus off-peak capacity.

2.3.6 Electrical Transmission Corridors

The Corridor receives hydroelectric power through the province-wide B.C. Hydro grid system (see Figures 2-2 through 2-4). Kitimat and Terrace are both principal load centres. Terrace is the location of the District and Regional offices of B.C. Hydro. Kitimat is connected to Kemano by two 287 kV transmission lines to serve the Alcan smelter and the townsite. In 1966, service to the townsite was taken over by B.C. Hydro. This power is supplied by B.C. Hydro's purchase of surplus energy generated by Alcan's Kemano generating station. The present contract also ensures a supply of 1,200 GWh/year to Terrace to the end of 1983.[3] The Kemano station has an overall combined installed capacity from the plant's eight generators of 896 MW and a maximum output of 860 MW.[21]

To ensure that Terrace's electrical needs were met, B.C. Hydro built a single 287 kV transmission line and constructed the Skeena substation near Terrace.[6] Previously Terrace had been serviced by a 60 kV line from Kitimat. By 1978, B.C. Hydro's peak demand had increased to 145 MW which is near the present limit of Alcan's surplus capacity.

Potential demand for electricity was estimated by B.C. Hydro for 1981-87 and by the provincial government to 1990. An estimated total B.C. Hydro bulk load demand of 250 MW by 1987 was defined as: 85 MW for specified uses, and 165 MW for unspecified use. Of the 165 MW of unspecified power, 70 MW would be consumed at Kitimat, 35 MW at Hazelton and Terrace, and the remaining 60 MW in the Stikine-Iskut area.[6] The provincial government, however, predicts that the demand for power by residential users will increase from 150 MW in 1980 to 350 MW by 1990. No projection was presented for industrial users.[21]

Long range plans to service growing demand includes additional transmission capacity to reinforce the existing B.C. Hydro grid. The extension of the 500 kV transmission line from Prince George to Terrace, or the Skeena Substation has been completed. However, an additional expansion of the 500 kV line to Prince Rupert is still under investigation. Potential energy in the range of 2800 MW, or 13,000 GWh/yr, could also be generated by the B.C. Hydro Stikine/Iskut project and transmitted by a 500 kV line by 1991.

Another alternative would depend upon the success of Alcan's application to the provincial government for the Kemano Completion Project.[21] An alternative energy source could also involve co-generation of energy from wood wastes by the forestry industry. However, excess energy from this source cannot be sold until changes have been made to existing legislation to allow for the sale of such surplus energy.[22]

The existing B.C. Hydro grid system can accommodate an additional load of 5-10 MW within a 10-16 km distance of existing transformer stations.

2.3.7 Water Supplies

In the Kitimat area, there are three main sources of potential water service. They are shown in Table 2-5.

Present water licences allow a withdrawal of 11.4 m^3/s from the Kitimat River, which is the main source of industrial and domestic water. This licenced water supply is allocated as shown in Table 2-6.

Alcan holds two additional water licences, one for 0.6 m^3/s from Anderson Creek, and a second for 0.05 m^3/s from Moore Creek. Both of these are held in reserve.[5]

The reservoir capacity for Kitimat District is 9,454,968 L/day. The water source consists of an infiltration gallery to the Kitimat River. Alternative sources of water to meet potential future demand would be derived from the Little Wedeene River and Jesse Lake.[37]

The District of Terrace obtains its water supply from the Skeena River and Spring Creek. The data outlined below refers to flow capacity as compared to static capacity. An infiltration gallery along the Skeena has an average output of 4,390 to 7,120 L/min, with a maximum total capacity of 20,419,356 L/day.[22] A 10" gravity line running from a dam on Spring Creek north of Terrace supplies an additional 2,670 L/min. or 3,848,400 L/day. All water receives standard chlorination and fluoridation treatment.[22] The existing system has a storage capacity of approximately 1,400,450 L/day.[4] As it was designed to serve a population of 35,000, it will be sufficient to meet demand for the next 10 years. A possible gravity-fed water supply from the Deep Creek watershed could augment the existing supply, if necessary.[22]

TABLE 2-5
KITIMAT AREA WATER SOURCES

	Flow (m^3/s)	
	Mean Annual	Minimum Daily
Kitimat River	135.0	9.20
Little Wedeene River	17.2	0.96
Jesse Lake	18.0	1.00
Hirsch Creek	19.3	4.40
TOTAL:	189.5 m^3/s	15.56 m^3/s

Note: Robinson Lake forms part of local watershed reserve which has presently unknown water potential.

Source: Wright Engineers Ltd. and H.N. Halvorson Consultants Ltd. Evaluation of a Metallurgical Complex in B.C., 1979.

Inland Waters Directorate, Water Resources Branch, Water Survey of Canada. Surface Water Data, British Columbia, 1981. Ottawa, 1982.

TABLE 2-6
WATER LICENSES ON KITIMAT RIVER

User	Licenced Amount*	Amount Used**
	(m^3/s)	(m^3/s)
Alcan	2.0	1.4
Eurocan	1.9	1.3
Municipality	7.5	-
TOTAL:	11.4 m^3/s	2.7 m^3/s

* Wright Engineers Ltd., and H.N. Halvorson Consultants Ltd. Evaluation of a Metallurgical Complex in B.C. 1979.

** Bell, Leonard M., and R.J. Kallman. The Kitimat River Estuary Status of Environmental Knowledge to 1976 - Report of the Estuary Working Group Canada Dept. of the Environment, Regional Board Pacific Region, West Vancouver, B.C. 1976.

Outlying areas are generally serviced by individual wells. However, in the Thornhill area there are 11 small independent water systems augmenting the service to two of the local communities. The major independent water service in Thornhill is Woodlands Utilities, whose system has a capacity of 500,000 L. In addition, two school systems are in operation, the Copper Mountain Elementary School system which has a 4,546 L holding tank, and the School Board system, which has an 18 m perforated pipe infiltration gallery and a 568,250 L capacity barred concrete reservoir.[31]

2.4 DEMOGRAPHICS

2.4.1 Current Population Distribution Patterns

The Kitimat-Terrace Corridor includes the population of both Kitimat and Terrace District Municipalities, as well as the outlying rural area constituting Census Subdivision C (see Table 2-7). Of the Regional District of Kitimat-Stikine, the Corridor has consistently supported approximately 73% of the total Regional population. In 1981, of the 30,832 Corridor inhabitants, 42% or 12,814 lived in Kitimat, 35% or 10,914 resided in Terrace and 7,104 or 23% lived in Census Subdivision C.[21] This population distribution pattern has been consistent from 1961 through 1981, although Subdivision C experienced the greatest rate of population increase.

As an indication of population distribution in the outlying areas, Table 2-8 provides a breakdown of unincorporated residential developments in the Terrace area. This

TABLE 2-7
KITIMAT-TERRACE CORRIDOR POPULATION GROWTH, 1961 TO 1981

Census Division	1961	1966	1971	1976	1981
Kitimat	8,217	9,792*	11,803	11,956	12,814
Terrace	5,904*	8,637	9,991*	10,251	10,914
Census Subdivision C	1,762	3,273	5,789	6,473	7,104
TOTAL	15,919	21,702	27,583	28,680	30,832
Regional District of Kitimat-Stikine	23,031	29,745	37,326	38,718	41,974

Sources: Interministry Working Group on Northwest B.C. Background Paper - Economic Development in Northwest British Columbia. April, 1982. Government of British Columbia.

Ministry of Economic Development. B.C. Regional Index. 1978.

Statistics Canada, 1981.

* Indicates boundary changes from previous census

TABLE 2-8
UNINCORPORATED RESIDENTIAL DEVELOPMENTS IN TERRACE AREA, 1976

Center	Population
Thornhill	4,023
Jackpine Flats	128
Lakelse Lake	263
Highway 16 East	580
Usk	196
New Remo	148
Old Remo	30
Kitsumkalum	60
Kalum Lake Drive	484
TOTAL	5,912

Source: Regional District of Kitimat-Stikine, Thornhill Official Settlement Plan, 1980.

unorganized residential growth, or rural sprawl, presents potentially serious problems in terms of future servicing costs and land use conflicts.[29]

2.4.2 Historic Population Growth Trends

Incorporated in 1953, the Kitimat District encompasses 32,200 ha. The original plans for the community developed by Alcan were designed to accommodate a population of 50,000. The 1981 census statistics reveal a population of 12,814 distributed relatively evenly among three distinct neighbourhoods, Nechako, Kildala and Whitesail. Kitimat has a young population; the median age in 1976 was 24.[10]

According to the Community Official Plan, Kitimat has experienced an average annual population increase of 1.6% since 1970; however, the District does not anticipate continued growth at this rate.[10] This is partially attributable to a decrease in household size from 3.9 persons in 1976 to 3.5 in 1979 and the present employment opportunities (see Table 2-9). The Ocelot development is not included in this evaluation. Thus, stimulus to population growth in the form of industrial development would appear necessary to provide the boost required to maintain a high growth rate.

In 1981, the District of Terrace had a population of 10,914.[33] As a resource town, Terrace is particularly sensitive to world market fluctuations. Based on population growth over a 15 year period between 1961 and 1976, an annual rate of increase of 3.7% was considered to be representative of the up and down cycle of Terrace.[6] On this basis, the following population estimates were projected in the Official Plan for Terrace: 1986 - 14,700; 1991 - 17,700; and 1996 - 21,200. However, the decline in direct forestry-related

TABLE 2-9
KITIMAT LABOUR FORCE, 1978

Alcan	2,400
Eurocan	1,200
Government	650
Service and Commercial	750
Other	900
TOTAL	5,900

Source: District of Kitimat. Official Community Plan, 1980.

employment, which supports a significant proportion of the population, renders these estimates to be overly optomistic for the immediate future.

In general, Terrace has a young population although compared to Kitimat, the 20 to 24 year age group is slightly smaller due to the attraction of schools and jobs in southern B.C. (see Table 2-10) Also, the large population over 65 years of age is partially attributable to the Skeena View Lodge geriatric facility.

The historic growth pattern of the rural population (Census Subdivision C) has not been uniform. The population has essentially quadrupled between 1961 and 1981, to 7,104. It is anticipated that an economic surge in either Terrace or Kitimat could stimulate rapid growth in these unorganized residential areas, as the incentives of lower taxes, larger lots and freedom from bylaws and building regulations often outweighs the disadvantages of lower service levels.[29]

Subsection (d) of Table 2-10 indicates the population of the Corridor by mother tongue, as no information is presently available on the ethnic composition. This was based on recent 1981 information from Statistics Canada. Throughout the Corridor English-speaking inhabitants are most numerous. The next most numerous in Kitimat and Terrace are the Portugese-speaking inhabitants and in the outlying area, French-speaking inhabitants are the second most frequently encountered group.

The most recent information available on the Indian population is from the 1971 records of Statistics Canada (as questions of ethnicity are only addressed once every 10 years). In Terrace there were 575 Indians, or 5.8% of the community population, and in Kitimat 135 Indians or only 1.1%.

TABLE 2-10
POPULATION CHARACTERISTICS, 1981

	Kitimat	Terrace	Census Subdivision C	Total
(a) TOTAL POPULATION	12,814	10,914	7,104	30,832
Male	6,770	5,600	3,695	16,065
Female	6,045	5,315	3,405	14,765
(b) AGE GROUPS				
- under 15	4,370	3,135	2,120	9,625
- 15 to 19	1,270	1,145	690	3,105
- 20 to 24	1,390	1,055	770	3,215
- 25 to 34	2,630	2,100	1,555	6,285
- 35 to 44	1,700	1,405	935	4,120
- 45 to 54	1,280	990	545	2,815
- 55 to 64	605	555	315	1,475
- 65 to 69	80	165	80	325
- 70+	100	275	80	455
(c) PRIVATE HOUSEHOLDS				
- Total	3,865	3,370	2,235	9,470
- Average persons per household	3.3	3.2	3.1	3.2

(d) POPULATION ETHNICITY - BY MOTHER TONGUE

	Kitimat	%	Terrace	%	Census Subdivision C	%	Total	%
Total Population	12,810		10,910		7,105		30,825	
Mother Tongue								
English	9,145	71%	8,760	80%	6,115	86%	24,020	78%
French	300	2%	275	3%	410	6%	985	3%
German	640	5%	310	3%	235	3%	1,185	4%
Portugese	1,285	10%	440	4%	30	0.4%	1,755	6%
Punjabi	260	2%	340	3%	10	0.1%	610	2%
(e) INDIAN POPULATION								
Other Indian	10	(0.08%)	25	(.23%)	15	(.21%)	50	(.16%)

Source: Statistics Canada, 1981

2.4.3 Socio-Economic Issues

A study of this nature would be incomplete without a general comment on social and economic concerns of the population in the Corridor. This is not an impact statement; rather, it is a summary of the issues presented in previous reports, investigations, and servicing studies.

In the Census Division of Kitimat-Stikine, the employees of the Alcan aluminum smelter represent more than half of the manufacturing labour force. In another sector, one can note that in 1980, there were 1,532 people directly employed in the region in the forestry industry whereas in 1971, forestry provided employment for a total of 1,560. These statistics denote the importance of these two key industries in providing employment to the residents of the Corridor.

The average individual income for residents of the Corridor was slightly higher than the provincial average. In 1979, employees in Kitimat received an average of $15,364 (116% of the corresponding provincial figure) and in Terrace $14,025 (106%). Workers living in Census Subdivision C averaged $10,904 (82%). However, actual family incomes may be lower due to a lower rate of female participation in the workforce. Recent available statistics indicate that the unemployment rate in Economic Regions 98-99 which encompass the Regional Districts of Peace-Liard, Kitimat-Stikine, Skeena-Queen Charlotte and the Stikine unorganized area, was 21.9% in January 1983. No more detailed or localized information is available.

Social issues documented in the past, with reference to other development proposals, have included:

- land for housing and the provision of low-cost housing upon it;

- urban fringe (Thornhill) development;
- preservation of the quality of the environment;
- Indian land claims by the Haisla band, particularly the Kitamaat Village, whose claim was accepted by the Indian Claims Office in Ottawa for negotiation; and,
- preservation of agricultural land within the ALR.

Among the economic concerns are:

- the provincial government's proposal to develop Lakelse Lake Hotsprings as a tourist resort and local residents' proposals to develop the area with greenhouses or a more agriculturally-oriented use of the hot springs;
- the lack of industrial diversity in the Corridor, particularly secondary and tertiary industries; and,
- the proposal by the Ministry of Forests to establish a Provincial Forest of 20,482 ha in the southern portion of the Kitimat Valley.

2.5 LAND USE

2.5.1 Historic Development Trends

Past development trends largely account for present land use patterns and indicate likely directions for future development. This brief overview emphasizes the relation of changes in land and resource base utilization to changes in the Corridor economy. The two municipalities are discussed separately as is the Corridor between them.

(a) Kitimat

Kitimat developed as a result of the Aluminum Company of Canada's (Alcan) decision in the early 1950's to construct a major aluminum smelter at the head of the Douglas Channel.

Prior to the construction of the Alcan project, the area's only inhabitants were about 1000 natives living on the Kitimaat Indian Reserve, 9.6 km south of the present townsite. The community has been totally planned since its inception. Its target population is 50,000.

The Alcan project involved construction of a hydro power dam and plant, a port terminal, and the aluminum smelter. The plant went into production in August 1954 at an initial production capacity of 81,630 t/yr, and the capacity has grown over the years to 267,600 t/yr. The plant occupies 140 ha of land. Although other industries have located in Kitimat, Alcan continues to dominate the economy.

In 1969, a pulp, paper and lumber complex of 280 ha was completed by Eurocan Pulp and Paper Ltd. Eurocan is the second major industrial employer in Kitimat today.

By 1980, a number of smaller industries had also located in Kitimat. These included: an Ocean Cement plant; a Canadian Liquid Air plant, L.G. Scott's Asphalt & Concrete plant; and a Dairyland plant. Crown Zellerbach Ltd. and MacMillan Bloedel Ltd. both carry out logging operations from Kitimat using existing dock facilities and booming grounds.

Another recent industrial development in Kitimat was undertaken by Ocelot Industries Ltd. which recently completed construction of a methanol plant. The plant site utilizes 13.6 ha of industrial land.

(b) Terrace

Beginning as a small logging and farming settlement near the turn of the century, Terrace has traditionally been a self-reliant community; it remained this way until World War Two.

It was first inhabited in 1908 by linesmen working on the Yukon Government Telegraph line, then by prospectors, trappers, adventurers and homesteaders. After the railroad reached Terrace in 1911 it became a transportation and service centre for the surrounding area and northwestern B.C. With the exception of agriculture, the forestry, transportation, and service sectors have continued to dominate the community's economy. As transportation improved, more agricultural produce was imported and the importance of local agriculture decreased.

Four major events have provided stimulus for most of Terrace's growth. The first was the arrival of the Grand Trunk Pacific Railway. The demand for railway ties, access to new timber supplies, and means for exporting forest products caused a boom in the forestry industry around Terrace. By the late 1920's, Terrace had four sawmills, and many smaller portable mills were operating in the surrounding valleys. As its prominence in milling and transportation developed, related services and industries were attracted, thus strengthening Terrace's role as a regional service centre. Incorporated in 1927, Terrace covers 2,100 ha.

Despite this growth, the community was still very small. In 1940, the town had a population of only 350. World War Two was the next event to spur development. Terrace became a military base for 3,000 men, plus an additional 300 temporary construction workers came to construct the base's numerous buildings, a hospital, water and sewer system, and airport. This influx placed tremendous demands on local agriculture, forestry, retail and transportation services. Each of these sectors expanded. The army also built the Skeena Highway. By 1944, Terrace was connected by road to Prince Rupert and Hazelton. Following the war, the base was abandoned. The Village acquired the water and sewer system, the hospital and several public buildings. The airport was taken over by the Department of Transport and opened to public use. Many army buildings were bought by companies such as Canadian Cellulose Ltd.[12]

Forestry continued to boom after the war, due to the housing demand created by servicemen remaining in the area and as a result of new road access to uncut forests. At its peak, over 200 small sawmills were located throughout the region. As timber supply decreased, production consolidated into large permanent sawmills in Terrace, Prince Rupert, and Kitwanga. Despite the forestry boom, Terrace was still a small town with a population of 960 in 1951. Its forestry, agriculture and service activities were owned and operated by individuals and family firms. This condition changed with the arrival of large forestry companies.

The specific event responsible for a new growth phase was the issuance in 1948 of T.F.L. No.1 to Columbia Cellulose Ltd. which later became Canadian Cellulose when the company was acquired by the B.C. Government, and as a BCRIC subsidiary is now B.C. Timber. Although all the wood was initially shipped to the company's pulp mill in Prince Rupert, new jobs and offices were created in Terrace, as it became a key centre of Canadian Cellulose's logging operations. Crown Zellerbach and MacMillan Bloedel held cutting rights to most of the remaining timber land in the Corridor.

In 1959, another large company, Skeena Forest Products, built a new sawmill in Terrace. During the 1960's, the remaining independent sawmills in the area were bought up by large corporations; Columbia Cellulose (later Canadian Cellulose) purchased the Pohle mill in 1968 and started producing lumber from its saw logs. This mill, now the largest producer in Terrace, employed 278 in 1979. Price-Skeena Forest Products, which was also purchased by Canadian Cellulose, is the second largest lumber producer. It employed 300 people in 1979. In total, the forestry companies today utilize 145 ha of industrial land in the community.

A significant event contributing to Terrace's development was the development of the Alcan plant at Kitimat. Initially providing local construction work, it now provides permanent employment for about a hundred Terrace residents. More importantly, it strengthened Terrace's service sector. Kitimat has always depended upon Terrace services and facilities to meet many of its needs. Growth in this sector was also fueled by the expanding forest industry. Small industries, such as machine shops, welding and automotive repairs, developed in response to this demand.

Little has changed since the late 1960's. No major industries have located in Terrace since 1959. Tourism first became significant in the 1960's and increased throughout the 1970's. Consequently, the number of hotels, restaurants and car service stations increased through the 1960's and 1970's, particularly along the main arterials. Growth in the service industry sector includes development of the region's major shopping centres and the establishment of local offices for government, B.C. Hydro and the B.C. the Telephone Company.

(c) The Kitimat-Terrace Corridor

The Corridor between Kitimat and Terrace has been historically used for transportation, forestry, agriculture, recreation and tourism. In 1898, a trail was blazed from Kitimat to Terrace for transporting the mail.[12] Railway and highway construction came much later. The CNR line was completed in 1955 and the road was opened in 1956.

Logging in the Valley is also a recent occurrence, commencing in the 1960's. Eurocan was awarded timber rights to TFL No. 41 in 1966 and began logging in 1967. Crown Zellerbach and MacMillan Bloedel held cutting rights to most of the remaining timber lands in the Corridor.[23] The most intensive logging took placed in the late 1960's and early 1970's. By 1973, much of the Corridor had been logged.[22] The entire area is expected to be cut by 1983. Some cutover areas have been planted with new seedling stock. The remaining land has been left to regenerate naturally.

The Corridor, historically an important recreation area for residents of the Prince Rupert-Kitimat Region, contains the recreational attraction of Lakelse Lake. In 1973, it was visited by 88 percent of Terrace households and 82 percent of Kitimat households.[30] Lakelse Lake has always been popular for water sports, fishing, camping, and for the hot springs nearby. Presently, about 10 percent of its shoreline is held as a provincial park. The Regional District has proposed that the lake, and a large area around it, become a regional recreation area.

There are ten key recreation areas in the Kitimat sector of the Corridor. These are: Hirsch Creek Park and Canyon, Hirsch Creek, West Kitimat River, Sentinel Hill, Radley Park, Minette Bay, Robinson Lake Area, Clague and Squirrel Mountains, and Douglas Channel. In the Terrace area, regional recreation facilities and campgrounds include Kitsumkalum Ski Hill, Terrace Lions Park, Thornhill Golf Course, Lakelse Hot Springs and Park, Terrace Mountain, Red Sail Lake and Kitsumkalum Lake Park, Kleanza Creek and the Exchamsiks Provincial Campground.

Much of the valley bottom surrounding Terrace is good agricultural land. Originally, it supplied almost all the produce for Terrace residents. A variety of food products are grown, including livestock, orchard fruits, berries, potatoes, forage and truck garden vegetables. Approximately 4,000 ha of the Corridor is within the Agricultural Land Reserve.[24] Figures 2-5, 2-6, 2-7 delineate the boundaries of Agricultural Land Reserves located in the Corridor. Also included in these figures are the boundaries of the proposed provincial forest within the Corridor.

2.5.2 Past Investigations of Industral Suitability

Over the years various firms and government agencies have investigated the suitability of the Corridor for different industrial uses. Table 2-11 lists the major industrial sectors investigated in matrix form, with additional background information. None of the enterprises listed in this table has been developed at present. Generally, the industrial developments outlined in the table, exhibit similar characteristics to those presently found in the Corridor.

These characteristics tend to include:

- a heavy industrial orientation;
- the processing of primary resource products;
- generally high energy requirements; and,
- the production of goods which are exported from the region.

Existing industries were generally attracted to the Corridor because of its proximity to tidewater, the availability of cheap electricity, the abundance of vacant flat land, and the proximity to forest and mineral resources. These factors, plus the facilities and services of the two main communities

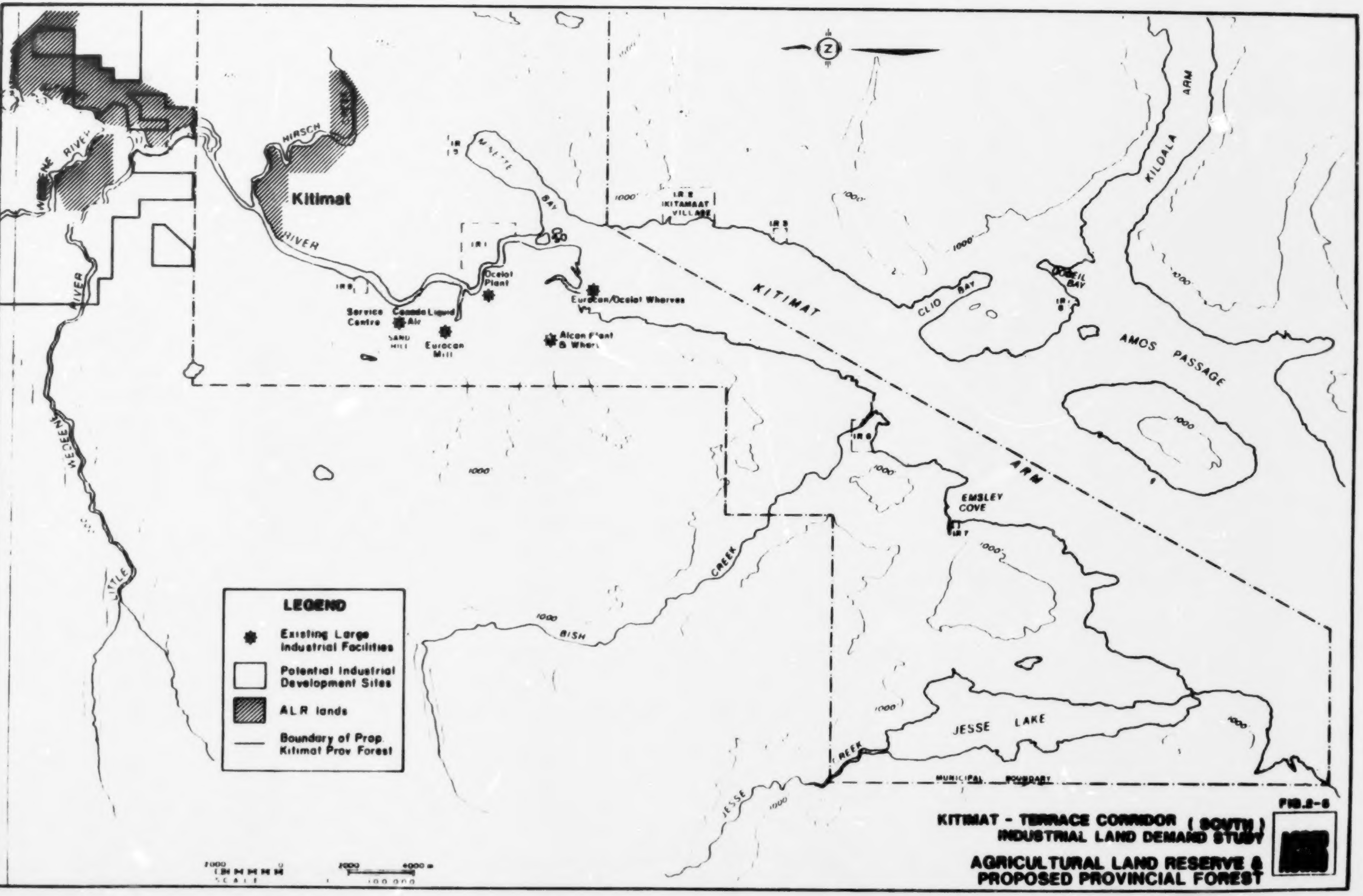

LEGEND
✱ Existing Large Industrial Facilities
☐ Potential Industrial Development Sites
▨ ALR lands
— Boundary of Prop. Kitimat Prov Forest
Kitimat
HIRSCH
RIVER
KITIMAT
ARM
KILDALA
ARM
AMOS PASSAGE
CLIO BAY
MINETTE BAY
EMSLEY COVE
JESSE LAKE
JESSE
CREEK
BISH
CREEK
WEDEENE RIVER
LITTLE
RIVER
IR 2 KITAMAAT VILLAGE
IR 1
IR 3
IR 5
IR 6
IR 7
IR 8
IR 13
Service Centre
Canada Liquid Air
SAND HILL
Eurocan Mill
Ocelot Plant
Eurocan/Ocelot Wharves
Alcan Plant & Wharf
1000'
MUNICIPAL BOUNDARY
N
SCALE
2000 0 2000 4000 m
1 : 100 000

FIG.2-6

KITIMAT - TERRACE CORRIDOR (SOUTH)
INDUSTRIAL LAND DEMAND STUDY

AGRICULTURAL LAND RESERVE &
PROPOSED PROVINCIAL FOREST

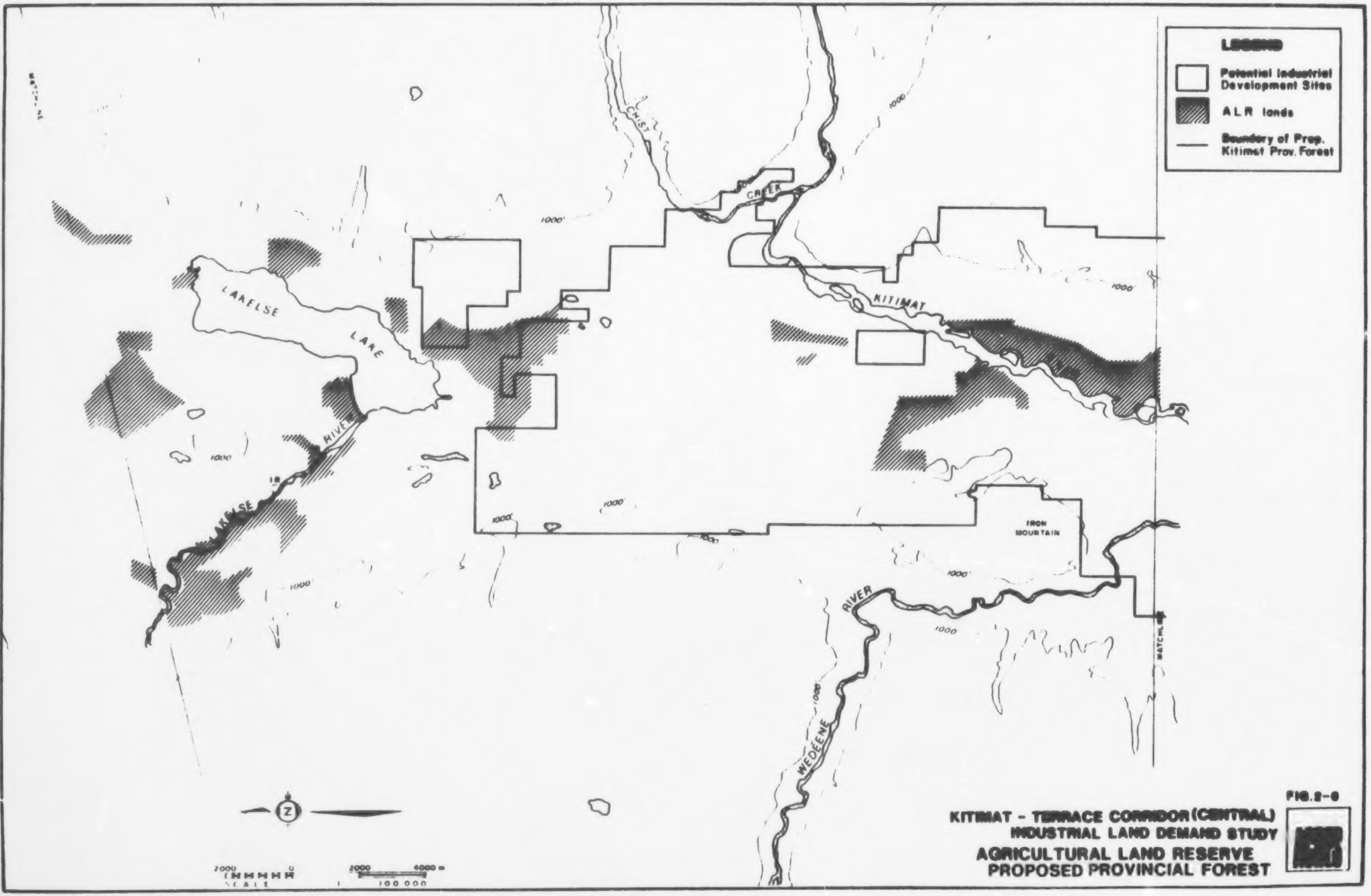

LEGEND
Potential Industrial Development Sites
ALR lands
Boundary of Prop. Kitimat Prov. Forest
LAKELSE LAKE
LAKELSE RIVER
CHIST CREEK
KITIMAT
IRON MOUNTAIN
WEDEENE RIVER
MATCHLINE
1000
SCALE 1 : 100 000
2000 0 2000 4000 m

FIG.2-6

KITIMAT - TERRACE CORRIDOR (CENTRAL)
INDUSTRIAL LAND DEMAND STUDY

AGRICULTURAL LAND RESERVE
PROPOSED PROVINCIAL FOREST

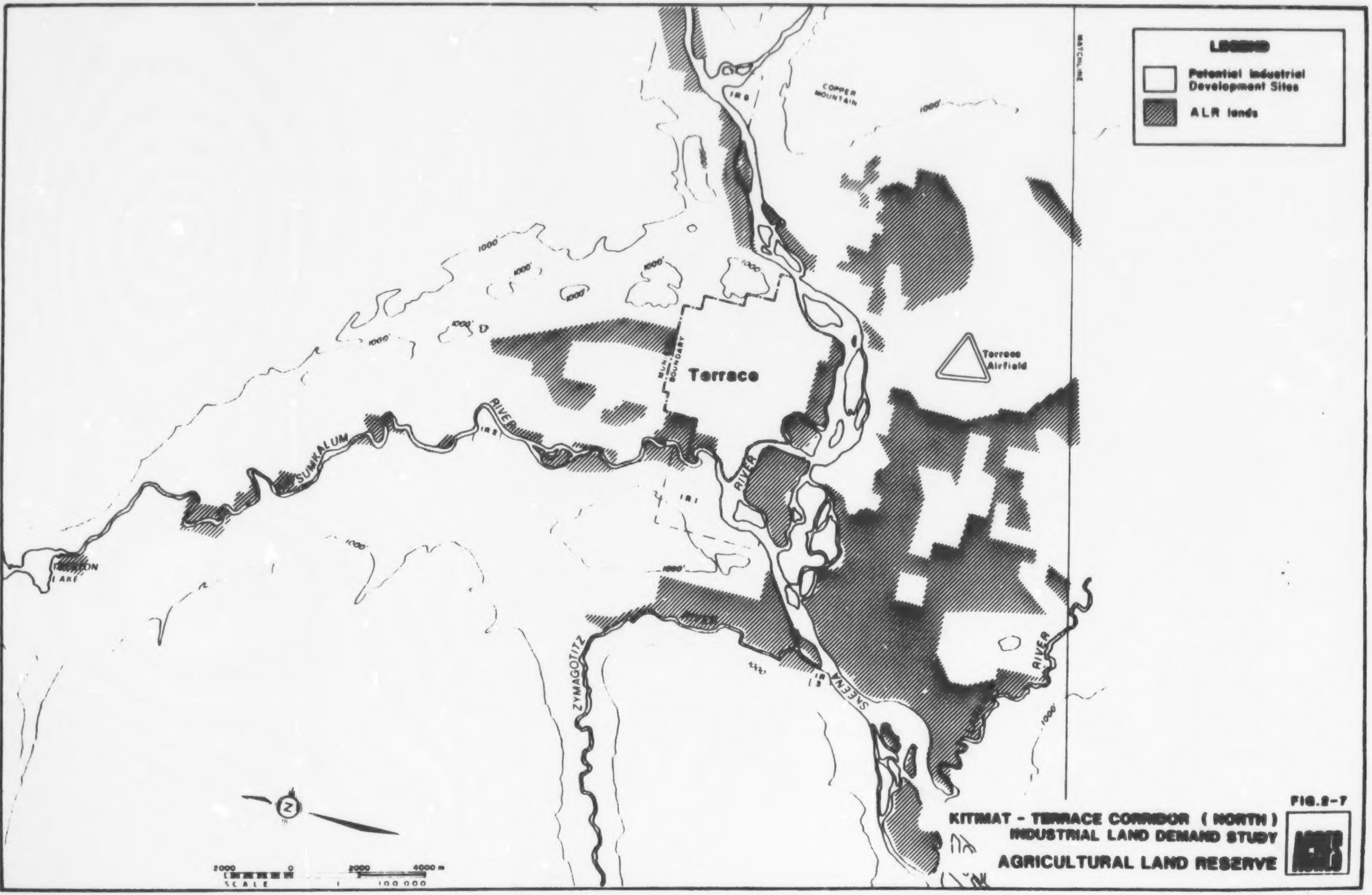

LEGEND
Potential Industrial Development Sites
▨ ALR lands
MATCHLINE
COPPER MOUNTAIN
1000'
IR 6
Terrace
BOUNDARY
Terrace Airfield
RIVER
IR 1
IR 2
SUMKALUM
RIVER
LAKE
ZYMAGOTITZ
RIVER
SKEENA
IR 3
RIVER
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.2-7

KITIMAT - TERRACE CORRIDOR (NORTH)
INDUSTRIAL LAND DEMAND STUDY
AGRICULTURAL LAND RESERVE

TABLE 2-11
PAST SITE INVESTIGATIONS FOR SPECIFIC PROJECTS

SECTOR	COMPANY/AGENCY	COMMENTS
FORESTRY:		
Pulp and Paper	Ministry of Economic Development (early 1970's)	- considered locations outside Corridor
Sawmill	Eurocan Pulp & Paper Ltd. (1982)	- considered Wedeene site
Plywood	Ministry of Economic Development (early 1970's)	- considered northwest region generally
Newsprint	Ministry of Economic Development (early 1970's)	- addition to existing pulpmills at Kitimat and/or Prince Rupert
METALLURGICAL PROCESSING:		
Aluminum Smelting	Aluminum Company of Canada Ltd.	- considered northwest region generally - expansion of up to three more smelters - development of Kemano Completion Project
Zinc Smelters or a complex processing copper, lead, magnesium and ferroalloy	Federal Dept. of Energy, Mines and Resources and B.C. Ministry of Economic Development	- 6 sites investigated in B.C., in order of preference they were: Squamish, Port Hardy, Emsley Creek (near Kitimat), Smith Island (near Prince Rupert), Wedeene (near Kitimat), and Prince George
Steel Mill		
• Integrated Mill	N.K.K. Steel Co. & B.C. Government (early 1970's and ongoing)	- investigated entire valley, especially Wedeene, Dubose and Thunderbird sites
• Blast Furnace	B.C. Development Corporation (ongoing)	- investigated Wedeene site and Dubose site
OIL AND GAS:		
Liquified Natural Gas	Various consortiums (1980-82)	Prince Rupert region preferred, Kitimat area (Bish Cove) preferred by RIMGAS
Petrochemical Processing	Dome and Westcoast Transmission Consortiums (1980-82)	Prince Rupert region preferred, Kitimat a possibility
Ammonia/Urea Processing	B.C. Government, (1981-82) (Companies: Westcoast Transmission Ocelot Industries Ltd.)	Kitimat, Powell River
Oil Pipeline/Refining	Transmountain Pipeline (1970's)	- oil pipeline running length of corridor - oil storage and some possible refining at Kitimat

TABLE 2-11
PAST SITE INVESTIGATIONS FOR SPECIFIC PROJECTS
(cont'd)

SECTOR	COMPANY/AGENCY	COMMENTS
OTHER MANUFACTURING:		
Cement	Ministry of Economic Development (1971 report)	- probable location near Terrace at existing quarry
Chlorine/Caustic Soda	Ministry of Economic Development (1971 report)	- possible sites in Kitimat, Prince Rupert or Terrace
PORT/TERMINAL:		
Public Terminal & Cruise Ship Terminal	Alcan (1976) & B.C. Harbours Board (1977)	- construction of 1 berth in Kitimat Harbour
Bulk Terminal	Alcan & B.C. Harbours Board (1977)	- construction of 1 or 2 berths in Kitimat Harbour with preference for sites in proximity to industrial land
Oil Port	Transmountain Pipeline (1970's)	- construction of 2 berths and oil loading and storage facilities at Kitimat Habour
General Cargo	Alcan & B.C. Harbours Board (1977)	- construction of 2 berths at Kitimat Harbour
Forest Products	B.C. Harbours Board (1977)	- construction of 1 or 2 more berths at Kitimat Harbour
Local Commercial/ Recreation Used	B.C. Harbour Board (1977)	- investigated additional moorage for pleasure craft and small area for tugs, seaplanes and fishing boats
OTHER TRANSPORTATION:		
Railway Marshalling Yards	CNR (early 1970's)	- investigated Copper City Flats near Terrace

Sources:

- Acres Consulting Services Ltd. Extracted from various studies previously undertaken in the Corridor.
- Bauder, E.M. and A.V. Gray. Economic Development of the Regional District of Kitimat-Stikine. B.C. Provincial Dept. of Industrial Development, Trade and Commerce, the Aluminum Company of Canada Ltd., and the Regional District of Kitimat-Stikine. 1971.
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- Wright Engineering Ltd. and H.N. Halvorson Consultants Ltd. Evaluation of a Metallurgical Complex in B.C. B.C. Ministry of Economic Development, 1979.

in the Corridor are also the attributes that would attract other prospective industries to the area.

Hence, the historic reasons for industry locating in the Corridor may continue to dominate in the future, and therefore, it is anticipated that the type and pattern of future industrial development would likely follow established trends. Most of these past investigations, whether initiated by the public or private sector, identified potential areas suitable for industrial development.

2.5.3 Current Land Use Patterns

Kitimat land patterns are less conventional than Terrace's. Sprawl is nonexistant, industry is completely separated from residential and commercial areas, and streets do not follow the normal grid pattern. As noted earlier the total area of the Municipality encompasses about 32,000 ha. Presently, 400 ha are developed as townsite, and another 400 ha are occupied by industry. Industrial development is confined to a long strip of land west of the Kitimat River; this area houses the four existing developments: Ocelot, Alcan, Eurocan and the Service Centre. Yet, it also contains an additional 2,000 ha of suitable, undeveloped land.[10]

Terrace land use patterns are conventional. The commercial area of 67 ha forms the city core and includes three shopping centres. The industrial area lies south and west of the commercial area. About 125 ha of this is occupied, while 35 ha of serviced industrial land and an additional 140 ha of unserviced land are available. The residential area is predominantly west and north of the town centre, with some also to the south.[22]

Several rural subdivisions are outside the Municipality, the most notable of which is Thornhill, on the south bank of the Skeena River. In 1961, virtually no one lived in Thornhill. Presently, over 5,000 people reside there, attracted primarily by its lower tax rates. It also has suitable land for industrial uses. If Thornhill amalgamates with Terrace, the Municipality will be faced with financing the servicing of Thornhill. For this reason, Thornhill's future is an unresolved issue in the area.

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3.0 POTENTIAL INDUSTRIAL SITES

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3.1 SELECTION CRITERIA FOR POTENTIAL INDUSTRIAL SITES

Twenty one potential industrial development sites were identified within the Kitimat-Terrace Corridor. The selection of these parcels, which range in size from 30 to 3,300 ha, was based primarily on terrain criteria. Earlier in 1982, Acres conducted a terrain evaluation of the Corridor in connection with an unrelated assignment. Potential industrial development sites isolated in the course of that exercise are delineated in Figures 3-1 through 3-3.

As well, sites which were previously identified by the Regional District, and those mentioned by questionnaire respondents during the preparation of this report, were included where appropriate. In order to accommodate all sites within the region which exhibited a potential capability to support large-scale industry, the boundaries of the study area were extended beyond the strictly defined Corridor to include the immediate coastline of Douglas Channel and Kildala Arm (see Figure 1-1). Inclusion of these sites provides a more complete summary of the prospective industrial land supply.

In summary, four data sources provided the most valuable information for selecting site locations. In order of priority they were: Acres' 1982 Steel Mill Site Selection Study, the Long Range Planning Studies of the Regional District of Kitimat-Stikine, the Official Community Plan for Terrace, and various Corridor related development proposals submitted to the B.C. and Alberta Governments.

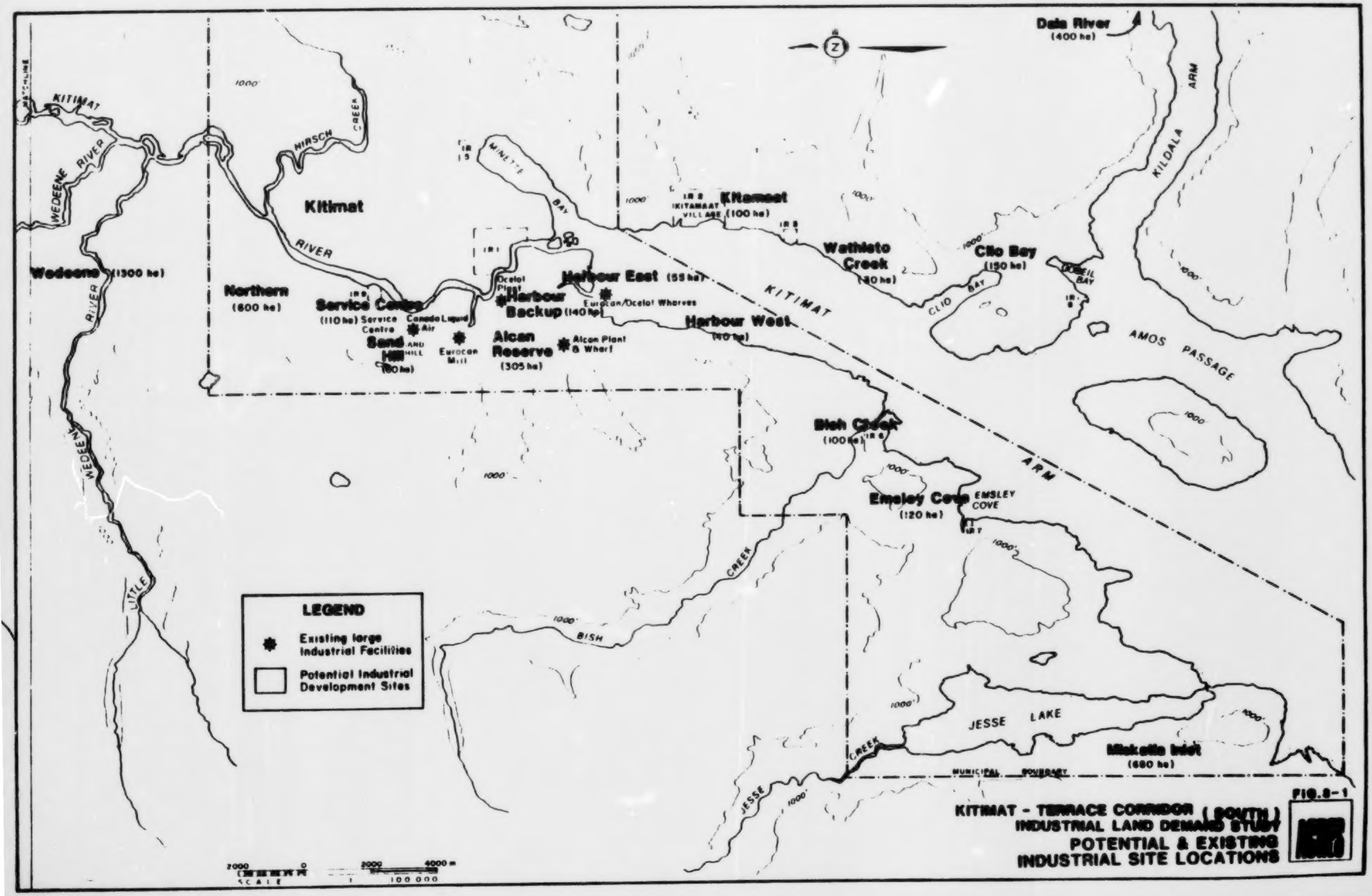
Dala River
(400 ha)
KILDALA ARM
AMOS PASSAGE
KITIMAT ARM
Clio Bay
(150 ha)
CLIO BAY
DORIEL BAY
IR 8
Wathlsto Creek
(80 ha)
IR 8
Kitamaat
(100 ha)
IR 8
KITAMAAT VILLAGE
MINETTE BAY
IR 15
IR 1
Kitimat
HIRSCH CREEK
KITIMAT
RIVER
WEDEENE RIVER
Wedeene (1300 ha)
WEDEENE RIVER
LITTLE
Northern
(600 ha)
IR 5
Service Centre
(110 ha) Service Centre
Canada Liquid Air
Sand Hill
(60 ha)
SAND AND HILL
Eurocan Mill
Alcan Reserve
(305 ha)
Alcan Plant & Wharf
Ocelot Plant
Harbour Backup (140 ha)
Harbour East (55 ha)
Eurocan/Ocelot Wharves
Harbour West
(40 ha)
Bish Creek
(100 ha)
IR 6
BISH CREEK
Emsley Cove
(120 ha)
EMSLEY COVE
JESSE LAKE
JESSE CREEK
Miskatla Inlet
(680 ha)
MUNICIPAL BOUNDARY
1000'
Z
LEGEND
Existing large Industrial Facilities
Potential Industrial Development Sites
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.8-1

KITIMAT - TERRACE CORRIDOR (SOUTH)
INDUSTRIAL LAND DEMAND STUDY
POTENTIAL & EXISTING
INDUSTRIAL SITE LOCATIONS

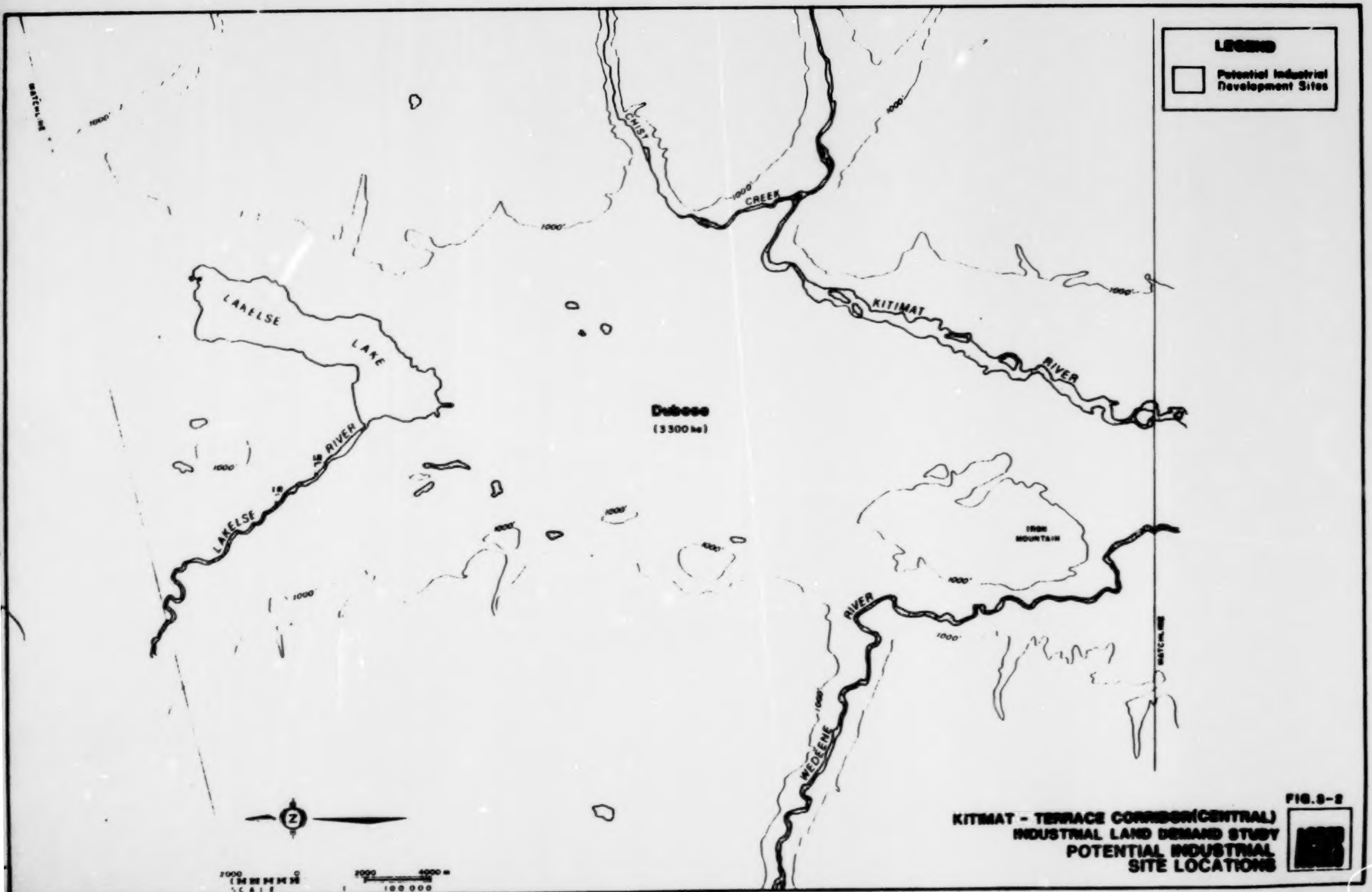
LEGEND
Potential Industrial Development Sites
CHIST CREEK
KITIMAT RIVER
LAKELSE LAKE
LAKELSE RIVER
WEDEENE RIVER
IRON MOUNTAIN
Dubose
(3300 ha)
1000'
MATCHLINE
16
Z
2000 0 2000 4000 m
SCALE 1:100 000

FIG. 8-2

KITIMAT - TERRACE CORRIDOR (CENTRAL)
INDUSTRIAL LAND DEMAND STUDY
POTENTIAL INDUSTRIAL
SITE LOCATIONS

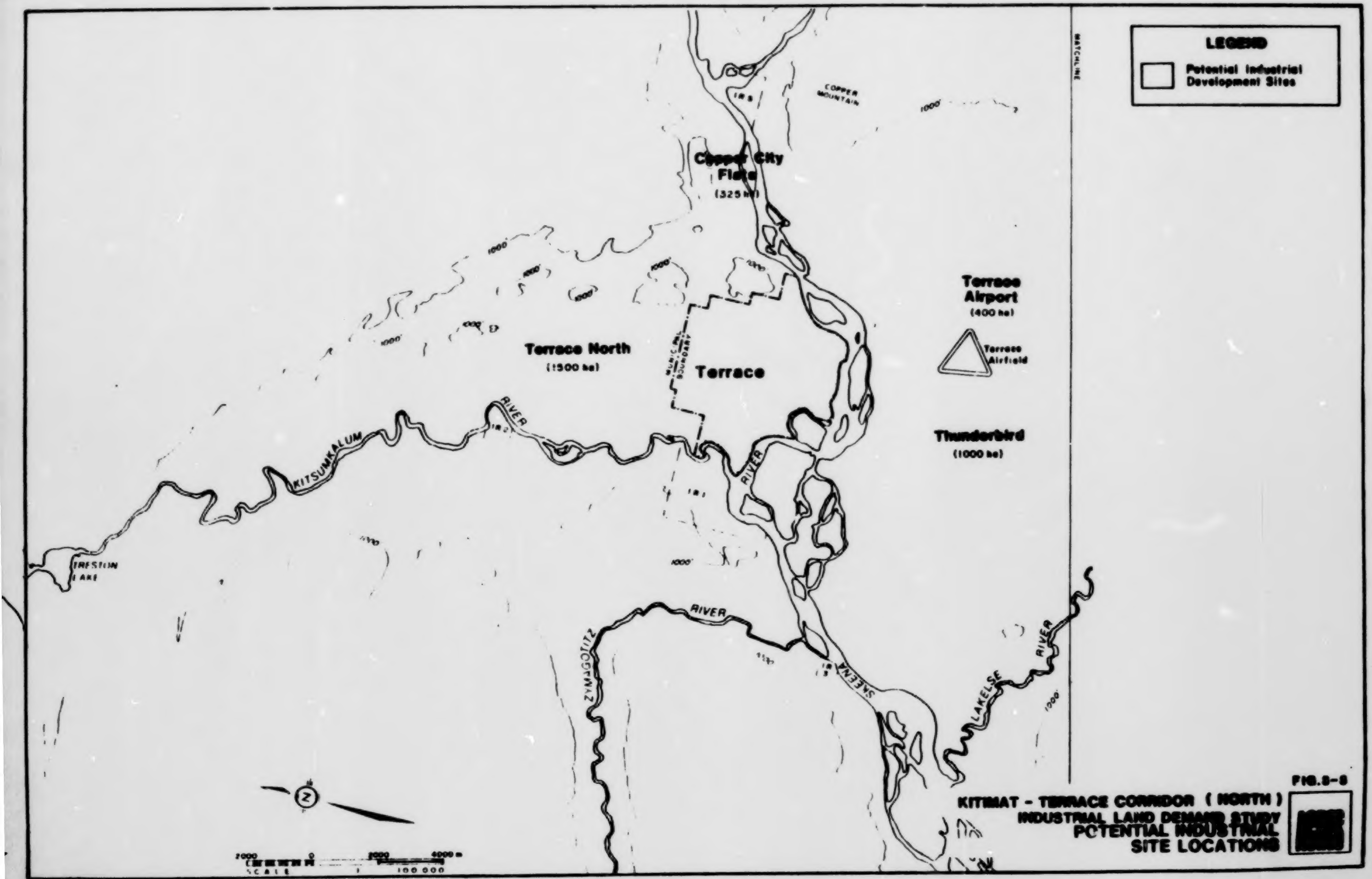
LEGEND
Potential Industrial Development Sites
MATCHLINE
COPPER MOUNTAIN
1000'
I.R. 1
Copper City Flats
(325 ha)
Terrace Airport
(400 ha)
Terrace Airfield
Terrace North
(1500 ha)
MUNICIPAL BOUNDARY
Terrace
Thunderbird
(1000 ha)
KITSUMKALUM
RIVER
I.R. 2
RIVER
I.R. 1
TRESTON LAKE
ZYMAGOTITZ
RIVER
SKEENA
LAKELSE
RIVER
N
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.8-8

KITIMAT - TERRACE CORRIDOR (NORTH)
INDUSTRIAL LAND DEMAND STUDY
POTENTIAL INDUSTRIAL
SITE LOCATIONS

TABLE 3-1

POTENTIAL SITES FOR LARGE-SCALE INDUSTRIAL DEVELOPMENT

Sites with Port Access:		Area (ha)
● DOUGLAS CHANNEL SITES		
Miskatla Inlet		680
Emsley Cove		120
Bish Creek		100
Kitamaat		100
Wathlsto Creek		30
Clio Bay		150
Dala River		400
● KITIMAT HARBOUR AREA		
Harbour West		40
Eurocan Wharf		0*
Harbour East		55
Alcan Reserve		305**
Sites without Port Access:		
● SOUTH CORRIDOR		
Harbour Back-Up		140
Sandhill		60***
Service Centre		110
Northern		600
Wedeene		1,300
● NORTH CORRIDOR		
Dubose		3,300
Thunderbird		1,000
Terrace Airport		400
Terrace North		1,500
Copper City Flats		325
	TOTAL:	10,715 ha

* Although land is not available for development, use of existing Eurocan facilities considered negotiable by any new industries. The site occupies 55 ha.

** This land is presently owned by Alcan; however, developments of a short term nature may be acceptable.

*** Reflects current quarrying operations on Sandhill site. However, the potential available land when the present use terminates will be 60 ha.

The 21 sites selected on the basis of the above criteria were then categorized into sites with direct port access, and sites without direct port access. This division helps to separate out those parcels which might offer superior advantages in serving raw materials and finished product handling requirements of export-oriented industries located in the Corridor. The port related sites were then subdivided by location into:

- Douglas Channel sites, which are situated adjacent to potential port areas presently undeveloped; and,
- Kitimat Harbour sites, which are adjacent to or near the existing wharves operated by Ocelot, Eurocan and Alcan.

The inland sites were categorized as belonging to either South or North Corridor sectors.

Table 3-1 lists the 21 potential sites available for large-scale industrial development, as well as the total area of each site and the amount of the site which is undeveloped or available for industrial development. A brief description of each potential site is included below.

Appendix A provides additional details regarding terrain and foundation conditions, access, transportation, utilities, and potential land use conflicts in relation to agricultural land reserves, the proposed provincial forest and similar prospective constraints. It is important to note that the 21 sites were defined strictly in relation to their potential for accommodating industrial projects, irrespective of ownership current or future alternative land-use options, and environmental concerns.

Acres wishes to stress that the preliminary evaluation of foundation conditions is based upon existing data. On most sites, such data is both cursory and subject to field confirmation. While substantial efforts have been made to acquire a complete record of the surficial geological data base, assumptions and tentative extrapolations have been made.

Given the quality of the data, these should be viewed with extreme caution. Detailed field investigations will ultimately be required, and such work is almost certain to modify the speculative findings documented in this section and in the accompanying Appendix A.

3.2 POTENTIAL INDUSTRIAL SITES WITH DIRECT PORT ACCESS

3.2.1 Douglas Channel Sites

Six sites are located along the coastline of the Kitimat and Kildala Arms of Douglas Channel (see Fig. 3-1). The total available land is 1,580 ha, of which 68% (1,080 ha) is found in two large sites, the Dala River, and Miskatla Inlet sites. The remaining 500 ha is distributed among five smaller sites.

(a) Miskatla Inlet

Located 26 km south-southwest of Kitimat, this 680 ha parcel rises from sea level to an elevation of 60-120 m at the central portion of the site. There are indications that the surficial geology may be suitable for heavy industrial foundations. The site was identified in past investigations as being suitable for a steel mill or pulp and paper mill development. It is a potential port site as it has direct tidewater access. There are no existing utility services.

No land use conflicts were identified with the exception of a potential fisheries concern if a proposal to dam Jesse Lake is part of any prospective industrial development.

(b) Emsley Cove

This relatively flat, 120 ha site lies 18 km from Kitimat, between the Miskatla site and the town. Presently accessible by water only, the site rises to 30 m. It is underlain by extensive deposits of soft marine clays beneath the floodplain gravels of Emsley Creek. There are no existing utilities on site. No immediate land use or resource conflicts were identified other than those potentially associated with the relatively under-utilized Indian Reserve No. 7, located on the southern extremity of the site. Past industrial investigations involving this site included pulp mill and metallurgical processing (lead/zinc and steel) developments.

(c) Bish Creek

Also perched on the west side of Kitimat Arm, this 100 ha parcel possesses similar soil conditions to the Emsley Cove site. Having direct tidewater access, this potential port site was selected by an LNG facility proponent as a preferred location. It is 15 km from Kitimat, 8 km from the presently developed road. It has no utility services. Land use conflicts may exists in that a high archaeological potential is indicated, and because 80% of the site is located within an Indian Reserve. There are also potential fishery concerns in connection with any proposed alterations to Bish Creek.

(d) Kitamaat

Situated on the east side of Kitimat Arm, 8 km south of Kitimat, this relatively flat, 100 ha parcel is considered a potential port site with direct tidewater access. Although presently accessible via Minette Bay Road, the site has no rail or gas line linkages. Major water requirements might be met from the Robinson Lake Watershed reserve, or, if the requirements are small, from Wathl and Wathlsto Creeks which are on and adjacent to the site. Potential concerns arise from the present Indian use of parts of this site, which lie in Kitamaat Indian Reserve #2.

(e) Wathlsto Creek

This area was identified by Albertan interests as suitable for a coal slurry pipeline terminal. Although a 30 ha site is indicated, it could be expanded somewhat to a total site area of up to a maximum of 100 ha. Geotechnical conditions were considered in past studies as suitable for industrial foundations. The site has no utility services and only limited water resources from Wathl and Wathlsto Creeks. No significant resource or land use conflicts were identified.

(f) Clio Bay

Straddling the peninsula between Clio Bay and the mouth of Kildala Arm, this 150 ha site occupies a valley 17 km south of Kitimat. It is relatively flat (0-30 m elevation), and has no existing utility services. Potential water sources include the Dala or Falls Rivers to the east. No land use or resource conflicts were identified. However, due to the site's proximity to the foreshore, it has a moderately high archaeological potential.

(g) Dala River

This parcel is 22 km from Kitimat and lies beyond the strict boundaries of the Corridor. However, its size (400 ha) and potential for port development render it a potentially attractive location for industrial developments that might otherwise locate closer to Kitimat. The majority of the site is situated on the Dala River floodplain. The Dala River bisects the site. At present, there is gravel road access. A transformer station, part of the Kemano-Kitimat hydroelectric line, is located on the southeast corner of the site. Water would conceivably be available from the Dala River, although potential fisheries concerns may arise. No immediate land use conflicts were identified other than the power line and transformer station noted above. However, the site has a very high archaeological potential, primarily in the foreshore and immediate inland areas.

3.2.2 Kitimat Harbour Sites

There are four sites within the Kitimat Harbour area that have direct port access and are considered suitable for industrial development. The site presently occupied by the Eurocan wharf does not directly contribute to the total land area potentially available for industrial use. However, as it does offer the use of presently under-utilized terminal facilities, it has been included in the tabulation.

Of the total potentially available 400 ha, the Alcan Reserve comprises 305 ha, and is the largest site in the area. The remaining 95 ha is separated into three smaller adjoining sites which could potentially be consolidated in various combinations to accommodate an industry-specific land requirement.

(h) Harbour West Site

This rectangular 40 ha parcel occupies a 4.2 km strip of foreshore along the west side of Kitimat Arm. As a potential port site with direct tide water access, it has been considered for a tank farm/pumping station and oil pipeline terminal, as well as for a steel mill development. Three small streams cross the site. However, if required, freshwater would probably be pumped in from either the Kitimat River, or the Anderson and Moore Creeks to the north. The site is 8 km from Kitimat and presently is not serviced by any utilities, although major utilities are located nearby. There are no immediate land use conflicts in the zone.

(i) Eurocan Wharf Site

Although this 55 ha site is entirely utilized by the Eurocan deepwater terminal and has no additional land available for industrial development, these facilities are presently under-utilized. Therefore, the use of the loading, berth and storage facilities might be attractive to other potential industries if adequate leasing arrangements could be achieved.

(j) Harbour East Site

Occupying the eastern portion of the Kitimat Harbour area, this 55 ha, flat, estuarine site on the Kitimat River floodplain has been considered as a potential port site. There are no existing utilities. However, the Eurocan Wharf to the east has hydroelectric servicing, and a gas line is located approximately 2 km to the north to service the Alcan plant. There are no current land use conflicts, although the general area is classified as having a very high archaeological potential. Given the location and proximity to Minette Bay, significant environmental concerns are also apparent.

(k) Alcan Reserve

Owned by the Aluminum Company of Canada, this 305 ha reserve lies adjacent to the existing Alcan aluminum smelter, 4 km southwest of Kitimat. Generally a flat, estuarine site, it is crossed by Anderson and Moore Creeks. The surficial geology is comprised of bedrock overlain by approximately 60 m of compressible silts and clays, 30 m of gravel, and 0.6 - 6 m of organic material. Consolidation of the marine clays beneath existing Alcan facilities has, in the past, resulted in large settlements. The site has tidewater, road and rail access, as well as hydroelectric services. A gas line parallels the rail alignment along its eastern boundary. Water is potentially available from the Kitimat River. Although there appear to be no immediate land use conflicts, the foreshore areas are classified as having a high archaeological potential.

3.3 POTENTIAL INDUSTRIAL SITES WITHOUT DIRECT PORT ACCESS

3.3.1 South Corridor Sites

There are six inland sites within 6 km of Kitimat. These offer a potential 5,510 ha ranging in size from 60 ha to 3,300 ha parcels. Of these, the two largest sites consist of 4,600 ha. The remaining 310 ha is divided among three smaller sites.

(l) Harbour Back-Up

Located in the central portion of the Kitimat Delta, this flat, 140 ha site would probably require considerable site preparation due to the number of creeks and rivulets traversing it. Although there is no direct tidewater access, a road exists for materials transport to nearby harbour facilities. Other utilities include a hydroelectric line crossing the southern portion of the site, and a nearby gas line 1 km to the west, which services the Alcan plant.

No significant land use conflicts were identified. However, for ecological protection, a 150 m greenbelt designation applies to lands adjacent to the Kitimat River, and the south portion of the site is classified as having a high potential for archaeological resources. Past development investigations at this location have included tank farm/pumping stations for the oil pipeline terminal project, and more recently, Acres' studies for the proposed ammonia/urea plant.

(m) Sandhill Site

Compressed between the Kitimat River to the east and rugged terrain to the west, this 60 ha site is presently occupied by an active quarrying operation. Thus, the site is not presently available for industrial development. However, at the present rate of excavation, quarrying will be completed and the entire site should be available within the next 10 to 20 years. Road and rail alignments cross the southeast corner of the site, as does a gas line.

The nearest hydroelectric power is presently available at the Eurocan mill to the south, and the Kitimat Service Centre to the north. Two adjacent land use designations which should be taken into consideration by any potential developer at this location are the Clague Mountain Municipal Park and the 150 m greenbelt along the Kitimat River.

(n) Service Centre

This site, presently used for retail, service and light industrial uses, has 110 ha available for future industrial expansion. A relatively flat parcel, with an elevation of less than 30 m, it lies 3 km west of Kitimat. Utilities provided on site include gas, water, power, sanitary and storm sewers, telephone and telecommunication, and rail services. Fire protection and snow removal are also available. Land use concerns might include potential impacts of particular types of prospective industries on the adjacent Radley and Clague Mountain Parks. As well, the 150 m greenbelt along the Kitimat River may curtail eastern expansion of the site. No other significant resource or land use conflicts were identified.

(o) Northern Site

Situated 4 km northwest of Kitimat, this large 600 ha site has gently rolling terrain traversed by several creeks and gullies flowing west to east. Road and rail services parallel the eastern border of the site, a hydroelectric line crosses its central sector and a gas line traverses the western portion. It is anticipated that freshwater could be provided from the Kitimat River. The site is situated on the eastern boundary of Clague Mountain Municipal Park, and close to the 150 m greenbelt along the Kitimat River.

(p) Wedeene

Situated 6 km north of Kitimat, this 1,300 ha site is named after the Wedeene River which crosses the site flowing west-to-east, and which may influence siting alternatives in the central portion of the site. Past studies suggest that foundation conditions may be favourable for industrial development in the south portion of the site and unfavourable in the north half. The existing rail line parallels its eastern boundary. Hydroelectric and gas lines are found approximately 1 km from the site. The nearest water sources include the Wedeene and Kitimat Rivers. Potential land use conflicts, which might affect prospective industrial developments at this location, include:

- the fact that the northern, central and much of the southern portions of the site are within the proposed Kitimat Provincial Forest boundaries;
- its location adjacent to the northeast boundary of Clague Mountain Municipal Park; and,
- a potential fisheries conflict associated with the use of the Little Wedeene River.

The site has been investigated as a possible location for a number of projects including the steel mill, the lead/zinc smelter and the sawmill.

(q) Dubose

The largest of all identified developable sites, this 3,300 ha parcel lies in the centre of the Corridor, 22 km from Kitimat and 24 km from Terrace. It is crossed only by the Lone Wolf and Cecil Creeks in its southwest corner. Highway 25 parallels the eastern boundary of the parcel. The rail line runs adjacent to its western boundary. Hydro-electric and gas lines are located approximately 4 km to the east. Potential water sources include the Kitimat River and possibly two smaller creeks which could provide limited water supplies. Potential land use conflicts on this site include the following.

- the entire site, with the exception of a small area in its southwest corner, falls within the boundaries of the proposed Kitimat Provincial Forest; and,

- the site is located immediately south of the Lakelse Lake Regional Recreation area.

However, the parcel has been identified as a potential steel mill site, and as suitable for a major industrial development park.

3.3.2 North Corridor Sites

In the Terrace area, four sites totalling 3,225 ha were isolated. Two sites are relatively large, encompassing 1,000 and 1,500 ha respectively. The two remaining are 400 and 325 ha.

(r) Thunderbird Site

This 1,000 ha site on a relatively level plateau, immediately west of the Terrace Airport, is approximately 5 km from Terrace. Alwyn Creek crosses the central portion of the site. Overall foundation conditions may be favourable. There is an existing industrial road adjacent to its eastern boundary and additional east-west road alignments have been proposed. The existing rail line passes through the central portion of the site, a hydroelectric line crosses its southern portion, and a gas line lies adjacent to its north boundary. Possible water services include the Skeena or Lakelse Rivers. Alwyn Creek is a potential minor water source. Potential land use conflicts include the following:

- an agricultural land reserve which occupies 50% of the site;

- the parcel is situated immediately north of the Lakelse Lake Regional Recreation area; and,

- the Terrace airport lies immediately east of the site.

(s) Terrace Airport

Of the 1,331 ha airport lands controlled by Transport Canada, 400 ha are available for industrial development. Three kilometers south of Terrace, the relatively flat site provides good surface drainage. Present indications are that foundation conditions may be favourable. The site is presently accessible by road (Highway 25) and rail (on its west side). Electrical services would be extended from the airport grounds, and a gas line crosses the site.

Freshwater is potentially available from the Skeena River. There are no significant resource conflicts, although possible interference with the operation of Terrace Airport would pose limits on the types of industries (or industrial processes used) at this location, and the associated structures. The Federal Department of Transport is presently undertaking a study to determine the best alternative uses for this area.

(t) Terrace North

This is the only site identified north of Terrace. It consists of 1,500 ha on a relatively flat plateau, of which 500 ha are on the Kitsumkalum River floodplain. Access is via Kalum Lake Road and various unimproved roads through its central and eastern portions. The nearest rail line (Prince George - Prince Rupert) lies 4 km to the south of the site. There are no existing utilities. Hydroelectric lines run 2 km to the south, and 3 km to the west of the parcel. Water is potentially available from the Kitsumkalum or Skeena Rivers. Potential land use conflicts or concerns include the following:

- the Kitsumkalum Mountain Recreation Area which lies directly northwest of this site; and,

- approximately 50% of the site is located within an agricultural land reserve.

(u) Copper City Flats

Occupying riverfront along the Skeena, 3 km east of Terrace, this 325 ha site is entirely situated within a 200-year floodplain. The site includes the 40 ha Shremp Island and a 1,500 m sand bar joining the island to the mainland. However, division of the site by water is intermittent. Access to the site could be made available via the proposed West Skeena Forest Access Road. An existing rail line passes through its central sector. There are no on-site utilities. Hydroelectric lines pass approximately 3 km to the southwest and gas lines approximately 2 km to the southwest. Freshwater could be obtained from the Skeena River. Potential land use conflicts include the following:

- extensive agricultural land reserve coverage of the area;
- the location of a watershed reserve 2 km to the north;
- potential conflicts with Terrace Airport operations; and,
- fishery management conflicts given the riverfront location.

The site has been considered in the past by CNR (Canadian National Railways) for a railway marshalling yard.

3.4 ENVIRONMENTAL CONSTRAINTS

In summary, terrain conditions pose significant problems in three of the areas identified for potential development. On the west side of Kitimat Arm, unstable underlying marine clays present a risk of mass wasting, potentially affecting development of the Emsley Cove and Bish Creek sites. The second area of concern are the Harbour Back-Up and Alcan Reserve sites. Past problems encountered with settlement of Alcan plant facilities due to underlying compressed silts and clays provide evidence of potential future problems associated with additional development in these zones. The third area of concern, occurring just north of Kitimat, is caused by the presence of marine silts and silty clays. The Northern site and the south portion of the Wedeene site may require considerable ground preparation and foundation support before a facility could be constructed.

Environmental constraints to industrial development arise from concerns relating to the preservation of soils, vegetation, and habitat which have led to the establishment of a Kitimat River greenbelt, agricultural land reserves and more recently, by the proposal to establish the Kitimat Provincial Forest. The sensitivity of Minette Bay and the Kitimat Estuary has also been noted in numerous studies.

At sixteen of the sites, industrial development would not constitute a direct fisheries hazard (excluding intake pipelines and outfalls). Streams and rivers, traversing or adjacent to sites, whose fisheries value has been confirmed, include Jesse Lake, Bish Creek, the Little Wedeene, Dala, Kitimat, and Skeena Rivers. At these locations, special attention may be required to minimize riverbed disturbances, watercourse diversion, alterations to flow and changes to vegetation bordering waterway, particularly during construction phases.

Other water related problems involve the potential for contamination of watershed reserves located close to identified industrial sites (e.g. Kitamaat, Copper City Flats). As well, extensive drainage of low-lying sites might alter existing geohydrological regimes, particularly in the Kitimat Harbour area.

3.5 SITE DEVELOPMENT PLANNING - CONCEPTUAL COST ESTIMATES FOR INFRASTRUCTURAL SERVICES

3.5.1 Basic Assumptions for Conceptual Cost Estimates

Total estimates were determined in this section, for servicing each of the potential industrial sites. The estimates are conceptual, based on 1:50,000 scale National Topographic Series (NTS) maps, with an attempt to allow for local terrain conditions. It is assumed the work would be carried out by small local contractors, requiring minimal mobilization, an allowance for which has been included. The distances are taken from the nearest existing service or utility to the site boundary, generally following the shortest route where possible.

Where the expression "connect" is used in place of a distance it has been assumed the service or utility is within 200 m of the site, in which case an allowance has been made to connect the service or utility to the site. The only exception is in the case of railroads, where the designation "connect" assumes that a rail line crosses the site but without a spur. Where the expression "serviced" is used the service, utility or railroad spur is in existence on the site.

The general assumptions and parameters for the cost estimates were as follows:

- all costs are 1982 dollars;
- design, survey, and engineering has been excluded;
- no rock excavation has been included;
- site works are assumed to be carried out by the developer, therefore, no costs for this have been included;

- in areas of steep slope, over marsh or other terrain requiring special treatment, an allowance has been made in the estimates accordingly, where such areas may be ascertained from topographic maps; and,

- estimates for associated ancillary works, and buildings that may be connected with the service or utility, have been excluded.

3.5.2 Description of Infrastructural Services

For the following services to be provided to each site, a standardized specification was selected to provide the minimal service acceptable for the proposed developments. By keeping the service characteristics static for each site, the differences in cost then reflect the various conditions and distances that must be overcome to service the site. Specific assumptions for each service were as listed below.

(a) Road

- 11 m wide roads;

- Crushed stone finish, asphalt paving is excluded;

- It should be noted that the desirability of asphalt would depend on the nature of the final proposed development and anticipated road useage. For the purpose of comparison in this report, it is considered preferable to compare the same specification for each road, and therefore, the minimum cost has been used by excluding asphalt, the costs of which may be added, if required, for a specific site.

- The line and level of the roadway is based upon the use of equal excavation and making up levels with the excavated material;

- Drainage ditches and culverts have been included;

- Bridges, where indicated, are simple reinforced concrete structures without sidewalks, railings, or any finishing;

- A major bridge is defined generally as a structure crossing a large stream or river, and a minor bridge as a small stream crossing. All bridge estimates are indicative only and should be revised on receipt of the exact road alignment, number of bridges, loadings, and spans.

(b) Rail

- A single track railroad;

- Notes (iii) to (vi) of road estimates may be applied equally to the rail estimates;

- Additional rolling stock is excluded.

(c) Gas

- 100 mm diameter underground coated and wrapped steel pipeline, installed and tested;

- Compressor stations are excluded;

- Junctions are taken from the existing line.

(d) Electricity

- 60 kV single circuit overhead transmission line;
- Transformers and substations are excluded, a typical substation cost including a 40/60 MVa transformer would be approximately $1,500,000;
- Junctions are taken from the existing line.

(e) Water

- Cost estimates for water services have not been included in the attached estimates. Upon further investigation into water services it was established that it is not possible to define the type of service (i.e. well or pipeline), the size of service, or treatment method, until the exact water requirements are known and the sources identified to meet these requirements. Being unable to establish a specification of any type for water services, it was considered that any estimate would only be misleading at this stage.

Based on the above assumptions, the conceptual costs of servicing each site are summarized on Table 3-2 and itemized by cost component in Appendix B.

3.5.3 Summary of Infrastructural Costs

Table 3-2 provides a site by site summary of the cost involved to provide road, rail, gas and electrical services to each potential development site. The dollar values given for the service connections of each of the 21 sites is a representative conceptual cost estimate that has two

TABLE 3-2

SUMMARY OF INFRASTRUCTURAL COSTS

Page 1 of 2

	ROAD		RAIL		GAS	ELECTRICITY	TOTAL COST
	Alignment	Bridges	Alignment	Bridges			
Douglas Channel Sites							
Miskatla Inlet	$17,000,000	$1,700,000	$ 25,000,000	$ 1,700,000	$ 4,000,000	$3,100,000	$ 52,500,000
Emsley Cove	7,000,000	800,000	13,100,000	800,000	2,000,000	1,500,000	25,200,000
Bish Creek	5,000,000	200,000	10,000,000	200,000	1,500,000	1,000,000	17,900,000
Kitamaat	2,200,000	-	10,500,000	2,000,000	2,100,000	20,000	16,820,000
Wathlsto Creek	6,400,000	-	15,800,000	2,000,000	3,100,000	400,000	27,700,000
Clio Bay	8,500,000	300,000	18,000,000	2,000,000	3,200,000	500,000	32,500,000
Dala River	19,000,000	800,000	27,800,000	2,800,000	4,600,000	20,000	55,020,000
	$65,100,000	$3,800,000	$120,200,000	$11,500,000			
• Sub-Total	$68,900,000		$131,700,000		$20,500,000	$6,540,000	$227,640,000
Kitimat Harbour Sites							
Harbour West	100,000	-	3,900,000	-	600,000	500,000	5,100,000
Eurocan Wharf	serviced	-	3,100,000	-	300,000	-	3,400,000
Harbour East	200,000	500,000	3,900,000	500,000	400,000	20,000	5,520,000
Alcan Reserve	Fully serviced						-
	$ 300,000	$ 500,000	$10,900,000	$ 500,000			
• Sub-Total	$800,000		$11,400,000		$1,300,000	$ 520,000	$14,020,000

TABLE 3-2
SUMMARY OF INFRASTRUCTURAL COSTS
Page 2 of 2

	ROAD		RAIL		GAS	ELECTRICITY	TOTAL COST
	Alignment	Bridges	Alignment	Bridges			
South Corridor Sites							
Harbour Back-Up	$ 700,000	-	$ 500,000	-	$ 400,000	$ 20,000	$ 1,620,000
Sandhill	100,000	-	600,000	-	30,000	20,000	750,000
Service Center	100,000	-	serviced	-	30,000	20,000	150,000
Northern	100,000	-	200,000	-	30,000	20,000	350,000
Wedeene	100,000	-	200,000	-	200,000	100,000	600,000
o Sub-Total	$1,100,000	-	$1,500,000	-	$ 690,000	$180,000	$ 3,470,000
North Corridor Sites							
Dubose	$ 700,000	$ 200,000	$ 200,000	-	$ 200,000	$ 100,000	$ 1,400,000
Thunderbird	100,000	-	200,000	-	30,000	20,000	350,000
Terrace Airport	100,000	-	200,000	-	30,000	20,000	350,000
Terrace North	100,000	-	6,000,000	$ 300,000	1,500,000	400,000	8,300,000
Copper City Flats	1,300,000	-	200,000	-	1,100,000	500,000	3,100,000
	$ 2,300,000	$ 200,000	$ 6,800,000	$ 300,000			
o Sub-Total	$2,500,000		$7,100,000		$ 2,860,000	$ 1,040,000	$ 13,500,000
TOTAL	**$ 73,300,000**		**$ 151,700,000**		**$25,350,000**	**$ 8,280,000**	**$258,630,000**

functions. First, to provide a tool for site comparisons, and second, to give the reader a conceptual understanding of development constraints at each site.

The most expensive sites to service include all of the Douglas Channel sites ($16,000,000+). The dollar value ranges from $16,820,000 for Kitamaat, to $55,020,000 for Dala River.

The next cost grouping falls in the $3,000,000 to $10,000,000 range. Three sites in this category are near Terrace (Terrace North, Terrace Airport, Thunderbird), and three in the Kitimat Harbour area (Harbour East, Harbour West, Eurocan Wharf). Again, rail service is the most costly item.

A comparison of the total cost of providing service connections to each of the 21 sites reveals that rail linkage was by far the most expensive service to provide. In general, it contributes approximately 59% of the total cost. Road construction/upgrading costs contribute the next greatest amount, 28%, then gas linkage at 9%, and electricity at 4%.

Sites whose rail cost exceeded the average 59% were:

- Douglas Channel - Kitamaat, Wathlsto Creek;
- Kitimat Harbour - Harbour West, Harbour East, Eurocan Wharf;
- Others - Sandhill, Terrace North.

This is attributable to either the distance involved to make the connection and/or the number of bridges included in the estimate. Sites with a significantly less than 59% proportion of overall costs incurred by rail connections were: Harbour Back-Up, Wedeene, Dubose and Copper City Flats. In all four cases, this was due to the fact that, although not presently serviced, the rail track either crosses or lies adjacent to them.

Roads are generally the next most expensive item to provide. Regardless of the type of development, it is necessary to have this minimum form of access to each site. The Dubose site is the only site whose road costs exceed the average proportion of costs. This is largely due its distance from existing road linkages and the probable necessity of constructing a bridge. Five sites have particularly low road linkage costs. These are Kitamaat, Terrace North and, in the Kitimat area: Harbour West, Harbour East and Sandhill.

Gas line costs, which only reflect the actual construction cost of the line, were found to be generally consistent for each site. Three site connections which contribute to a higher proportion of overall costs were: Harbour Back-Up, Wedeene and Copper City Flats. For the first two sites, the generally low overall costs tend to distribute each component input more evenly. In the third case, distance to the nearest connection is the critical factor.

For electrical connection costs, three sites were below the 4% average proportion of total costs, including Harbour East, and Dala River. This is due to proximity to existing lines and transformer stations. Sites whose costs exceed the average are Service Centre, Wedeene and Copper City Flats, due to the distance to the nearest connection.

3.5.4 Service Costs Comparison for each Potential Development Sites

For each site, a service cost per hectare of industrial land identified at each location was calculated for comparison purposes. These are summarized on Table 3-3. Two sites were excluded. They are, the Eurocan Wharf site due to the absence of any acreage involved, and the Alcan Reserve where infrastructural services are already in place.

The average service cost per hectare was $24,520. All the sites which had a ratio cost/hectare exceeding the average were located in the Douglas Channel and Kitimat Harbour areas, plus the Harbour Back-up Site. Those sites with a lower-than-average cost/hectare ratio were located in the South and North Corridor areas.

To facilitate a better understanding of the range of costs, a breakdown of the component units used to prepare the cost estimates are given in Table 3-4.

In conclusion, it should be stressed that for each proposed development, various combinations of infrastructural services would be required. Thus, in order to arrive at a reasonable assessment of costs for providing these services for a specific project proposal to one of several alternative sites, a separate cost comparison would be required.

TABLE 3-3
COST OF INFRASTRUCTURAL SERVICES TO EACH POTENTIAL DEVELOPMENT SITE

SITES	COST/HECTARE
Douglas Channel Sites	
Miskatla Inlet	$ 77,200
Emsley Cove	210,000
Bish Creek	179,000
Kitamaat	168,200
Wathlsto Creek	923,000
Clio Bay	216,700
Dala River	137,550
Average cost for Douglas Channel Sites	$273,090
Kitimat Harbour Sites	
Harbour West	$127,500
Eurocan Wharf	-
Harbour East	100,360
Alcan Reserve	-
Average cost for Kitimat Harbour Sites	$113,930
South Corridor Sites	
Harbour Back-Up	$115,700
Sandhill	12,500
Service Center	1,360
Northern	583
Wedeene	461
Average cost for South Corridor Sites	$ 26,120
North Corridor Sites	
Dubose	$ 424
Thunderbird	350
Terrace Airport	875
Terrace North	85,267
Copper City Flats	9,538
Average cost for North Corridor Sites	$ 3,290
AVERAGE COST OF SUPPLYING INFRASTRUCTURAL SERVICES TO ALL CORRIDOR SITES: $24,520	

TABLE 3-4
SUMMARY OF COST COMPONENTS
Page 1 of 2

SITES	ROAD			RAIL			GAS (km)	ELECTRICITY (km)
	Distance (km)	Bridges		Distance (km)	Bridges			
		Major	Minor		Major	Minor		
Douglas Channel Sites								
Miskatla Inlet	28	2	4	33	2	4	33	30
Emsley Cove	12	1	2	17	1	2	17	14
Bish Creek	8	-	1	13	-	1	13	10
Kitamaat	9	-	-	14	1	-	15	Connect
Wathlsto Creek	16	-	-	21	1	-	22	3
Clio Bay	19	-	2	24	1	-	25	4
Dala River	32	-	5	37	1	5	38	Connect
Sub-Total	124	3	14	159	7	12	163	61
Kitimat Harbour Sites								
Harbour West	Connect	-	-	5	-	-	5	4
Eurocan Wharf	Serviced	-	-	4	-	-	2	Serviced
Harbour East	Connect	1	-	5	1	-	3	Connect
Alcan Reserve	Serviced	-	-	Serviced	-	-	Serviced	Serviced
Sub-Total	-	1	-	14	1	-	10	4

TABLE 3-4
SUMMARY OF COST COMPONENTS
Page 2 of 2

SITES	ROAD			RAIL			Gas (km)	Electricity (km)
	Distance (km)	Bridges		Distance (km)	Bridges			
		Major	Minor		Major	Minor		
South Corridor Sites								
Harbour Back-Up	1	-	-	0.5	-	-	3	Connect
Sandhill	Connect	-	-	0.5	-	-	Connect	Connect
Service Center	Connect	-	-	Serviced	-	-	Connect	Connect
Northern	Connect	-	-	Connect	-	-	Connect	Connect
Wedeene	Connect	-	-	Connect	-	-	1	1
Sub-Total	1	-	-	1	-	-	4	1
North Corridor Sites								
Dubose	1	-	1	Connect	-	-	1	1
Thunderbird	Connect	-	-	Connect	-	-	Connect	Connect
Terrace Airport	Connect	-	-	Connect	-	-	Connect	Connect
Terrace North	Connect	-	-	7	-	2	10	4
Copper City Flats	2	-	-	Connect	-	-	6	5
Sub-Total	3	-	-	7	-	2	17	10
TOTALS	128	4	14	181	8	14	194	76

4.0 PROJECTED INDUSTRIAL GROWTH SCENARIOS

4.0 PROJECTED INDUSTRIAL GROWTH SCENARIOS

4.1 INTRODUCTION

A key purpose of this study is to assess the total demand for industrial land in the Kitimat-Terrace Corridor for the next 10 and 20 years. This was accomplished through a modelling exercise based on the results of contact with prospective developers, liaison with government agencies, and private industries. To effectively maximize the response from participants, a questionnaire was devised to accommodate four primary considerations: the expansion of existing industries; and, the introduction of new industries which may be suppliers of input or consumers of output from the existing industries and/or new ventures not related to existing industries and/or raw materials handling and export industries.

A probability model was then devised and applied, in four incremental phases, to develop alternative scenarios to reflect industrial project start-up and timing under three economic conditions: low, medium and high growth.

The results of the survey were analysed with regard to, first, the extent and quality of the questionnaire responses; and, second, the types of industries that indicated an interest in development in the Corridor.

Finally, to provide projected industrial development scenarios for the next 10-20 years, the probability assessment was combined with a time sequence ranking and presented for low, medium and high economic growth scenarios.

It should be noted that only the larger industrial projects were considered in this analysis. Small firms with only a few employees considering minor expansion were not integrated within the study. In part this was because appropriate data relating to such firms is largely unavailable. Also the incremental consumption of say 0.25 - 0.50 ha of land to accommodate the expansion of very small family run industrial operations is insignificant in relation to the many hundreds of hectares which would be dedicated to a large project.

Consequently, the analysis was restricted to those instances where capital expansion plans required land in excess of 1 ha and expenditure exceeding $1,000,000 in constant mid 1982 dollars.

4.2 METHODOLOGY FOR INDUSTRIAL GROWTH SURVEY

4.2.1 Development of Questionnaire

Two questionnaires were developed; one for private sector contacts and another for public sector contacts. The critical questions centred on the type, scale, and timing of prospective developments. In order to obtain adequate responses to these issues, the private sector questionnaire was organized into four main sections.

Section One, (Questions 1 to 3) addressed the identification by name, type of industry, nature and description of the expansion/new development. As well, it addressed two major areas of concern: the economic conditions required for the development to proceed and, the infrastructural requirements or constraints to development including transportation, resources and services.

Section Two (Question 4) of the questionnaire dealt with the probability of project go-ahead. On a scale of one to five the respondent was requested to provide an indication of the relative importance of infrastructural or economic conditions affecting that particular industry or industrial sector. As well, the respondent was to list, in order of importance, the five individual factors which were most essential to project go-ahead.

Section Three (Question 5) addressed the probable timing of the industrial project, based on the assumption that it will go-ahead. Specific dates, or a range of possible dates were requested. The respondent was asked to indicate, in order of importance, the five individual factors essential to timing. Qualifying questions were posed in order to assess the importance of the preferred date as compared to the net effect of the timing factors. Also, the participant was queried on the importance of economic versus infrastructural considerations to project timing.

Section Four of the questionnaire (Questions 6 and 7), posed leading questions to assist in identifying other possible associated developments (upstream or downstream) or any new industries possibly interested in locating in the Kitimat-Terrace Corridor.

A somewhat more general version of the described questionnaire was administered to public agencies and representatives of several citizen and/or public action organizations. In each interview, the participant was requested, on the basis of his intuitive knowledge of the area, which industries or industrial sectors would be likely to develop in the Corridor. For each identified industry, the respondent was queried on the economic and infrastructural requirements to facilitate industrial development.

As a final consideration of the participant's point-of-view, open-ended questions were posed to allow the respondents to express their particular opinions or mandates regarding the development of the Corridor.

4.2.2 Questionnaire Administration

There were two steps in Acres' selection of possible questionnaire participants. The initial survey included an extensive coverage of Vancouver, Terrace, Kitimat, and Victoria-based, public and private sector contacts. The second step involved follow-up on suggestions and leads generated by the initial participants. The questionnaire is reproduced in Appendix C, while a complete list of contacts can be found in Appendix D.

A total of 58 companies, private and public sector agencies were contacted. The geographic distribution of these respondents was as follows.

Location		Number of Contacts
Kitimat		10
Terrace		16
Vancouver		14
Victoria		12
Elsewhere		6
	TOTAL:	58

To ensure that Kitimat and Terrace based interest groups were given an opportunity to participate, arrangements were made through the staff from the Regional District of Kitimat-Stikine and the Municipal District of Kitimat to hold interviews in their respective local offices. On May 18 and 19, 1982, interviews were conducted in Terrace and Kitimat. Given the nature of the participants, only the general public sector questionnaire was used in most cases.

Designated government contacts in Victoria were interviewed on May 17, 18, and 19, 1982. These included the:

- Ministry of Agriculture and Food
- Department of Regional Economic Expansion
- Ministry of Lands, Parks and Housing
- Ministry of Transportation and Highways
- Ministry of Industry and Small Business Development
- Ministry of Forests
- Ministry of Energy, Mines and Petroleum Resources
- Ministry of Environment, and
- Ministry of Tourism.

From these initial contacts, additional potential projects were identified and pursued, either by telephone or personal interviews. Fourteen agencies were contacted in the Vancouver area, and six out-of-province contacts were made via long-distance telephone interviews. The participants interviewed were able to provide data on 11 potential projects which would be likely to locate in the Corridor.

4.2.3 Description of Probability Model

The probability modelling exercise was carried out in four phases, each addressing a specific requirement of the study. A description of the methodology can be found in Appendix E. The four phases were as follows:

- Phase 1: Determination of overall go-ahead probabilities for each project scenario.

- Phase 2: Establishment of a timing probability distribution for project start-up years from 1983 to 2003.

- Phase 3: Determination of joint annual timing and project start-up probability distribution on a per scenario basis from 1983 to 2003.

- Phase 4: Mutually exclusive rankings were devised for:
  - project scenarios by overall probability of go-ahead;
  - project scenarios for designated 5-year periods by probability of go-ahead;
  - alternative patterns of project combinations within designated 5-year periods.

The work in each phase was conducted within the context of three possible economic scenarios, low, medium and high growth. The interpretation of these economic growth conditions was based on constructing alternative ranges of average long-term annual increases in Provincial Gross Domestic Product expected to prevail over the next 21 years.

The data base used for this interpretation was a listing of the historical annual increases in constant dollar gross domestic product (GDP) for British Columbia between 1961-1980. This was derived from the British Columbia Economic Accounts, 1961-1980, published by the Central Statistics Bureau of the Ministry of Industry and Small Business Development (see Appendix E).

Accordingly, the range of parameters of economic growth were defined in constant dollar amounts, as outlined below.

- Low economic growth: The average annual increase in Provincial GDP assumed to be negative to +2.9 percent;

- Medium economic growth: The average annual increase in Provincial GDP ranges from +3.0 to +5.9 percent inclusive; and,

- High economic growth: The average annual increase in Provincial GDP assumed to be +6 percent or more.

Probabilities reflecting projected economic conditions over the forthcoming 21-year period were derived from the following four sources:

- Economic forecast indices designed for cost elements of major Canadian projects, and developed by key economic agencies. These indices and their data bases are listed in Appendix E;

- Probabilities supplied by the questionnaire respondents;

- Historical data bases used to extrapolate economic projections through linear or exponential time series; and,

- Subjective assessments collectively made by appropriate members of Acres staff.

The model was deliberately designed for the computer to incorporate those criteria which were felt would best suit the indicated requirements of the client. These criteria included:

- Simplicity of program construction and layout of results;

- Ensuring that the final computer model be made fully interactive. Acres computer facilities would be made available to the Client for future sensitivity runs, to test any desired changes in data or criteria; and,

- Simplification of assumptions wherever possible to facilitate application of mathematical principles.

4.2.4 Response to Questionnaire

As noted earlier, a total of 58 separate interviews yielded 11 potential projects which were then incorporated into the probability model. Nine questionnaires were completed for specific industrial proposals by representatives of the companies involved. The data for the remaining two prospective developments were obtained from appropriate government agencies. A summary of the 11 projects is listed in Table 4-1.

Most respondents to the questionnaire were very cautious. For example, although the respondents were willing to disclose the nature and scale of the proposed developments (Questions 1 and 2), all, with the exception of Eurocan, declined to address the specific details outlined in Tables B-1 and B-2, identifying economic and infrastructural requirements. In Questions 4 and 5 regarding project go-ahead and timing, questions requiring absolute answers were interpersed with relative, judgemental questions. Questions 6 and 7 were generally poorly answered by private sector respondents. However, most public sector contacts were able to provide a number of leads and suggestions.

4.2.5 Key Decision Factors

Questions regarding project go-ahead (Question 4) were answered by all participants with varying degrees of elaboration. All respondents indicated that selected favourable economic conditions were more, or much more, important than infrastructural requirements. However, in the case of the aluminum smelter and the oil pipeline terminal, the respondents indicated that economic and infrastructural concerns were of equal importance although each had initially

TABLE 4-1
POTENTIAL INDUSTRIAL DEVELOPMENTS

PROPONENT	PROPOSED DEVELOPMENT	COMMENT
(a) Eurocan	sawmill	North of Service Centre
(b) Alcan	aluminum smelter	Dubose site suggested
(c) Canada Liquified Air	air separation plant	New plant or expansion
(d) Ocelot	ammonia/urea plant	3 km north of Eurocan plant
(e) LNG Facility*	LNG export	Bish Cove proposed**
(f) Kitimat Pipe Line*	oil pipeline & terminal	Proposed 2 km south of Alcan
(g) Chieftain*	coal slurry pipeline	-
(h) B.C. govt.*	lead/zinc smelter	-
(i) B.C. govt.*	steel mill	Wedeene site proposed
(j) B.C. govt.*	copper smelter	-
(k) Alberta govt.*	coal slurry pipeline	Wathlsto Creek suggested

* Similar developments have been of interest to various potential proponents, of which the named party is among the most prominent of advocates.

** Subsequent to the administration of the questionnaire, the B.C. government accepted the Dome Petroleum Ltd. proposal to construct an LNG facility at Port Simpson. In light of this announcement, the realistic expectation of another LNG facility locating in the Kitimat-Terrace area would be considerably less than at the time this information was solicited.

selected economic factors as the most essential criteria for project go-ahead.

Each respondent identified a minimum of four, usually five, factors essential to project go-ahead. All 11 industrial developments were strongly dependent on the availability of a market of appropriate size. Market size was always listed in the first three considerations. Six of the 11 responses listed market size as the number one concern. It is important to note that two companies selected factors relating specifically to their particular industry as the most important factor. Eurocan cited the availability of capital as a foremost concern and Alcan indicated approval of the Kemano Completion Project as being of central importance.

Market price was indicated by 9 respondents as ranking first or second in importance. In many cases the respondents indicated that market size and market price were of equal importance when considered in the context of a questionnaire of this general nature. Although 8 prospective industrial respondents listed market price and size as the second most important factor, the remaining gave a range of factors, each relating more to industry specific requirements. For example, Eurocan cited the availability of technology as a concern; Alcan - the availability of labour; Kitimat Oil Pipeline - the availability of raw material; and for the copper smelter - Japanese tariffs.

The four next most frequently stated factors essential to project go-ahead included the availability of:

- affordable capital;
- raw material;
- technology; and,
- ancillary services.

These were ranked with varying degrees of importance. The only other two factors of particular note included the availability of appropriate technology and an adequate land base. Others mentioned were: inflation, market stability, approval procedures, environmental concerns and the cost of power.

4.2.6 Timing of Industrial Developments

The next phase of the questionnaire (Question 5) addressed the problem of establishing the probable timing of the proposed developments. For 8 of the 11 projects, no specific date or year for anticipated start-up was given and for two of these (air separation plant and steel mill) a possible range of start-up years is not available. The timing data for these two cases was then hypothesized on the basis of additional comments made by the respondent. For example, the scale and timing of the air separation plant depends largely on the expansion of new or existing 'upstream' industries that would create necessary market demand.

To assess the significance of the specified year or range of start-up years, each respondent was requested to indicate the importance of starting on or by the preferred year. Six of the 11 respondents stated that it was not important; Ocelot (ammonia/urea plant) and the proponent for the LNG facility indicated that it was quite important; and Eurocan (sawmill) stated that it was very important that the project go-ahead within the preferred time period. Thus, it was evident that, although each respondent had a tentative internal schedule, the actual timing of each project was again influenced most greatly by external factors and circumstances.

In most responses to Question 5.4, the criteria listed were almost identical to those already noted as essential to project go-ahead. Again, market size and price were the most frequently cited factors. These were also the most often ranked as the number one concern, except in the case of the aluminum smelter, where permit approvals for the Kemano Completion Project were still seen as being of utmost importance. The source of raw material (score: 5), cost of money (score: 5), and transportation concerns (score: 4) were also cited more frequently then other concerns. Environmental impacts were indicated as frequently as the availability of technology and the cost of labour. Other factors cited were: availability of services to the site, the availability of land, the Japanese tariff structure, market suitability, permit procedures and inflation.

Economic factors were consistently cited as essential to project timing, with the exception of the sawmill where infrastructural constraints were of greater concern than economic factors, and for the Celanese methanol terminal, where infrastructural and economic considerations were of equal importance.

4.2.7 Potential Secondary Developments

The final two questions were, in general, poorly answered. Few 'upstream' or 'downstream' industries interested in development within the Corridor, were identified even on the assumption that the respondents prospective development would progress as indicated in the questionnaire results. Those most frequently mentioned included: equipment repair shops and mechanic shops; a steel fabricating industry; possible production of formaldehyde, resins and acrylics; and a local distribution centre for natural gas.

4.3 PROBABILITY ASSESSMENT AND TIME SEQUENCE RANKING

4.3.1 Introduction

For each of the 11 projects, a series of development timing probabilities were calculated. Tables 4-2 to 4-5 illustrate the possible range of time periods for industrial development based on the computer output reproduced in Appendix F. Each computer printout page in Appendix F contains the results of analyses for a specified project scenario. Individual project scenarios were developed by generating, for each of the 11 potential projects in the Corridor, 3 sets of probabilities reflecting conditions of high, medium and low economic growth. Therefore, a total of 33 project scenarios are delineated in the Appendix.

Within each growth scenario four timing combinations were calculated with corresponding probability values listed. Each of the values represent an estimate of the percentage chance that the project will indeed go-ahead within the specified time period. That is, although a project may have a 90% overall probability of proceeding, for example, there may be a 60% probability of commencement between 1983 and 1987 and the remaining 30% probability of commencement spread throughout the other 5-year time blocks.

The fact that all 11 projects are listed in Tables 4-3 to 4-5 does not imply that each will go ahead. However, for those industrial developments most likely to proceed under each particular economic growth alternative, the most probable time periods are indicated. This includes the presentation of the most likely combination of start-up periods, based on the precalculated marginal probabilities for each period.

The second column in Tables 4-3 to 4-5, labelled "second best timing combination", is comprised of the 'next best'

TABLE 4-2

RANKING OF PROJECT BY OVERALL PROBABILTY OF GO-AHEAD

Low Economic Growth			Medium Economic Growth			High Economic Growth		
RANK	PROJECT	PROB'Y	RANK	PROJECT	PROB'Y	RANK	PROJECT	PROB'Y
1.	Sawmill	.46	1.	LNG Plant	.69	1.	LNG Plant	.90
2.	Ammonia/Urea Plant	.32	2.	Chieftain Pipeline	.62	2.	Ammonia/Urea Plant	.81
3.	Aluminum Smelter	.19	3.	Ammonia/Urea Plant	.61	3.	Sawmill	.81
4.	LNG Plant	.18	4.	Sawmill	.60	4.	Air Separation Plant	.77
5.	Alberta/Fluor Pipeline	.15	5.	Air Separation Plant	.49	5.	Chieftain Pipeline	.72
6.	Chieftain Pipeline	.15	6.	Alberta/Fluor Pipeline	.43	6.	Copper Smelter	.65
7.	Air Separation Plant	.14	7.	Steel Mill	.41	7.	Alberta/Fluor Pipeline	.65
8.	Steel Mill	.08	8.	Aluminum Smelter	.33	8.	Steel Mill	.63
9.	Lead/Zinc Smelter	.01	9.	Lead/Zinc Smelter	.30	9.	Lead/Zinc Smelter	.61
10.	Copper Smelter	.01	10.	Copper Smelter	.30	10.	Aluminum Smelter	.40
11.	Oil Pipeline Terminal	.01	11.	Oil Pipeline Terminal	.08	11.	Oil Pipeline Terminal	.08

TABLE 4-3

RANKING OF PROJECT TIMING COMBINATIONS BY PROBABILTY OF START-UP PERIODS:

LOW ECONOMIC GROWTH

PROJECT	Best (Most Likely) Timing Combination		2nd Best Timing Combination		3rd Best Timing Combination		Least Likely Combination	
	Period	Prob'y	Period	Prob'y	Period	Prob'y	Period	Prob'y
LNG Plant	1988 - 1992	.15	1983 - 1987	.04	- - -	—	- - -	—
Ammonia/Urea Plant	1988 - 1992	.17	1983 - 1987	.13	1993 - 1997	.01	- - -	—
Air Separation Plant	1998 - 2003	.06	1993 - 1997	.05	- - -	—	- - -	—
Chieftain Pipeline	1988 - 1992	.10	1983 - 1987	.05	- - -	—	- - -	—
Sawmill	1988 - 1992	.25	1983 - 1987	.21	- - -	—	- - -	—
Copper Smelter	- - -	—	- - -	—	- - -	—	- - -	—
Alberta/Fluor Pipeline	1998 - 2003	.10	1993 - 1997	.05	- - -	—	- - -	—
Steel Mill	1993 - 1997	.05	1998 - 2003	.01	- - -	—	- - -	—
Lead/Zinc Smelter	- - -	—	- - -	—	- - -	—	- - -	—
Aluminum Smelter	1993 - 1997	.07	1988 - 1992	.06	1998 - 2003	.04	1983 - 1987	.03
Oil Pipeline Terminal	- - -	—	- - -	—	- - -	—	- - -	—

TABLE 4-4

RANKING OF PROJECT TIMING COMBINATIONS BY PROBABILTY OF START-UP PERIODS: MEDIUM ECONOMIC GROWTH

	Best (Most Likely) Timing Combination		2nd Best Timing Combination		3rd Best Timing Combination		Least Likely Combination	
PROJECT	Period	Prob'y	Period	Prob'y	Period	Prob'y	Period	Prob'y
LNG Plant	1988 - 1992	.45	1983 - 1987	.24	- - -	—	- - -	—
Ammonia/Urea Plant	1988 - 1992 or 1983 - 1987	.31	1988 - 1992 or 1983 - 1987	.31	- - -	—	- - -	—
Air Separation Plant	1993 - 1997	.19	1988 - 1992	.16	1998 - 2003	.06	1983 - 1987	.04
Chieftain Pipeline	1983 - 1987	.39	1988 - 1992	.22	- - -	—	- - -	—
Sawmill	1983 - 1987	.35	1988 - 1992	.25	- - -	—	- - -	—
Copper Smelter	1993 - 1997	.14	1988 - 1992	.12	1998 - 2003	.06	- - -	—
Alberta/Fluor Pipeline	1993 - 1997 or 1998 - 2003	.17	1993 - 1997 or 1998 - 2003	.17	1988 - 1992	.08	- - -	—
Steel Mill	1993 - 1997	.15	1988 - 1992	.12	1998 - 2003	.07	1983 - 1987	.04
Lead/Zinc Smelter	1988 - 1992 or 1993 - 1997	.10	1988 - 1992 or 1993 - 1997	.10	1983 - 1987	.08	1998 - 2003	.04
Aluminum Smelter	1988 - 1992	.12	1993 - 1997	.10	1983 - 1987	.08	1998 - 2003	.05
Oil Pipeline Terminal	1998 - 2003	.04	1993 - 1997	.03	1988 - 1992	.01	- - -	—

TABLE 4-5

RANKING OF PROJECT TIMING COMBINATIONS BY PROBABILTY OF START-UP PERIODS:

HIGH ECONOMIC GROWTH

	Best (Most Likely) Timing Combination		2nd Best Timing Combination		3rd Best Timing Combination		Least Likely Combination	
PROJECT	Period	Prob'y	Period	Prob'y	Period	Prob'y	Period	Prob'y
LNG Plant	1988 - 1992	.60	1983 - 1987	.30	- - -	—	- - -	—
Ammonia/Urea Plant	1983 - 1987	.55	1988 - 1992	.26	- - -	—	- - -	—
Air Separation Plant	1988 - 1992	.31	1983 - 1987	.20	1993 - 1997	.17	1998 - 2003	.09
Chieftain Pipeline	1983 - 1987	.51	1988 - 1992	.21	- - -	—	- - -	—
Sawmill	1983 - 1987	.56	1988 - 1992	.24	- - -	—	- - -	—
Copper Smelter	1988 - 1992	.26	1993 - 1997	.19	1983 - 1987	.12	1998 - 2003	.10
Alberta/Fluor Pipeline	1993 - 1997	.26	1998 - 2003	.22	1988 - 1992	.15	1983 - 1987	.03
Steel Mill	1988 - 1992	.27	1993 - 1997	.21	1998 - 2003	.08	1983 - 1987	.07
Lead/Zinc Smelter	1988 - 1992	.22	1983 - 1987	.20	1993 - 1997	.14	1998 - 2003	.06
Aluminum Smelter	1988 - 1992	.18	1983 - 1987	.10	1993 - 1997	.08	1998 - 2003	.03
Oil Pipeline Terminal	1993 - 1997	.04	1998 - 2003	.03	1988 - 1992	.01	- - -	—

combination of alternative start-up periods for each industry. In this column, the associated marginal probability indicated is the second highest for each project.

The rationale for assigning the probabilities to Column Two is based on the unlikely assumption that the start-up periods in Column One ultimately prove to be incorrect. Therefore, the next most likely combination of start-up periods can be found in Column Two. Column Three, "the third best timing combination", is formulated in an analogous manner to Columns One and Two. It lists by project, that most likely combination of start-up periods assuming those periods indicated in Columns One and Two prove to be inappropriate.

Column Four (the furthest on the right) is also formulated in an analogous manner to the previous columns. It lists the resultant timing combinations of start-up periods, under the assumption that all those time periods in Columns One through Three are incorrect. Thus, Column Four represents the worst case, or least likely combination of start-up periods associated with each project.

For the purposes of this probability assessment, however, only the most likely scenario will be discussed for low, medium and high growth economic scenarios.

4.3.2 Low Growth Scenario

Under low growth conditions, the general economic constraints to industrial development are reflected in the low probability values assigned by the computer output to the 11 proposed industries. The industries having approximately 20% or better probability of go-ahead include in ranked order:

the sawmill (46%), the ammonia/urea plant (32%), aluminum smelter (19%), LNG plant (18%). The time sequence for these would be:

Consecutive Timing	Industry	Ranking by Overall Probability of Go-ahead
1988-92	- Sawmill	1
	- Ammonia/Urea Plant	2
	- LNG Plant	4
1993-97	- Aluminum Smelter	3

The sawmill development, though apparently imminent, was not assigned a 100% probability, due to the fact that the weight of the external economic factors listed as constraints to go-ahead mitigate Eurocan's internal decision to proceed. The deferment of the ammonia/urea plant and LNG plant to the 2nd quarter of the 21-year time horizon reflects the combination of permit, and procedural delays and the restructuring of the economics for these projects. The aluminum smelter was listed in the 3rd quarter again, due to lengthy and problematic permit procedures (for the Kemano Completion Project) as well as further alternative site investigations and general world market conditions.

Other industries having a 14-15% probability of go-ahead comprise the following possible time schedule:

Consecutive Timing	Industry	Ranking by Overall Probability of Go-ahead
1988-92	- Coal Slurry Pipeline (Chieftain)	6
1998-2003	- Air Separation Plant	7
	- Alberta/Fluor Pipeline	5

4.3.3 Medium Growth Scenario

Under medium economic conditions, five of the prospective developments listed below have a 50% or better overall probability of go-ahead. The time sequence is as follows.

Consecutive Timing	Industry	Ranking by Overall Probability of Go-ahead
1983-87	- Coal Slurry Pipeline (Chieftain)	2
	- Ammonia/Urea Plant	3
	- Sawmill	4
1988-92	- LNG Plant	1
	- (Ammonia/Urea Plant)	(3)
1993-97	- Air Separation Plant	5

It is important to note that the aluminum smelter is not included in this list. This reflects the conservatively low probability value assigned to the success of the Kemano Completion Project application which would provide the necessary power for another smelter at this location. However, this factor does not constitute the sole explanation.

In general, the primary concerns of market price and size for each of these five industries would be alleviated by an upswing in the economy. Four of these industries are almost exclusively export oriented. Only the air separation plant may be partially dependent upon the other regional industries to provide a firm market for their particular product, liquid oxygen.

4.3.4 High Growth Scenario

Under high growth conditions, the alleviation of economic constraints to industrial development contributes to the high probability values for project initiation. Five industries demonstrate a 70% or higher probability of go-ahead. The time sequence and ranking of these projects is as follows.

Consecutive Timing	Industry	Ranking by Overall Probability of Go-ahead
1983-87	- Ammonia/Urea Plant	2
	- Sawmill	3
	- Coal Slurry Pipeline (Chieftain)	5
1988-92	- LNG Plant	1
	- Air Separation Plant	4

Under high economic growth conditions, a wider variety of industrial development proponents would consider a location in the Kitimat-Terrace Corridor as viable and attractive. From the results generated, it is evident that these industries might be expected to develop within the first 10-year period. Industries having a 60-70% probability of go-ahead demonstrated the following time sequence.

Consecutive Timing	Industry	Ranking by Overall Probability of Go-ahead
1988-92	- Copper Smelter	6
	- Steel Mill	8
	- Lead/Zinc Smelter	9
1993-97	- Alberta/Fluor Pipeline	7

Again, three of four developments would commence in the first 10 years period. Only the coal slurry pipeline of the Alberta Government and Fluor Canada Ltd. would be delayed until the early 1990's as the demand for such a line would originate from the development of new mining interests requiring this service. It is also appreciated that there are significant technical and environmental concerns associated with the slurry pipeline, but these issues are beyond the scope of this study.

4.3.5 Time Sequence Ranking

A time sequence ranking was prepared for the three growth scenarios (see Table 4-6 and the associated Tables 4-7 through 4-9). The overall probabilities for each project were distributed among the five year periods as marginal probabilities according to calculations based on the blended timing distributions. The projects, ranked for each 5-year period by their marginal probability values, are not necessarily those which would be most likely to go ahead under the particular growth conditions specified.

Table 4-6 provides a list of the top five projects by marginal probability for each 5-year period. The asterisk indicates the significance of the project in terms of the overall probability of go-ahead.

TABLE 4-6

TIME SEQUENCE RANKING

1983 - 1987	1988 - 1992	1993 - 1997	1998 - 2003
LOW ECONOMIC GROWTH			
1. Sawmill*	1. Sawmill	1. Aluminum*	1. Alberta/Fluor Pipeline*
2. Ammonia/Urea Plant	2. Ammonia/Urea Plant*	2. Air Separation Plant	2. Air Separation Plant*
3. Chieftain Pipeline	3. LNG Plant*	3. Ammonia/Urea Plant	3. Steel Mill
4. LNG Plant	4. Chieftain Pipeline*	4. --	4. Aluminum Smelter
5. Aluminum Smelter	5. Aluminum Smelter	5. --	5. --
MEDIUM ECONOMIC GROWTH			
1. Chieftain Pipeline*	1. LNG Plant*	1. Air Separation Plant*	1. Alberta/Fluor Pipeline*
2. Sawmill*	2. Ammonia/Urea Plant*	2. Alberta/Fluor Pipeline*	2. Steel Mill
3. Ammonia/Urea Plant*	3. Sawmill	3. Steel Mill*	3. Air Separation Plant
4. LNG Plant	4. Chieftain Pipeline	4. Copper Smelter*	4. Aluminum Smelter
5. Lead/Zinc Smelter & Aluminum Smelter	5. Air Separation Plant	5. Lead Zinc Smelter* & Aluminum Smelter*	5. Lead Zinc Smelter
HIGH ECONOMIC GROWTH			
1. Sawmill*	1. LNG Plant*	1. Alberta/fluor Pipeline*	1. Alberta/Fluor Pipeline*
2. Ammonia/Urea Plant*	2. Air Separation Plant*	2. Steel Mill	2. Copper Smelter
3. Chieftain Pipeline	3. Steel Mill*	3. Copper Smelter	3. Air Separation Plant
4. LNG Plant	4. Ammonia/Urea Plant	4. Air Separation Plant	4. Steel Mill
5. Air Separation Plant & Lead/Zinc Smelter	5. Sawmill* & Lead Zinc Smelter*	5. Lead Zinc Smelter	5. Lead Zinc Smelter

* most likely timing for project development

TABLE 4-7

RANKING OF PROJECTS BY MARGINAL PROBABILITY OF GO-AHEAD IN FIVE-YEAR BLOCKS (1983 - 2003): LOW ECONOMIC GROWTH

	1983-1987		1988-1992		1993-1997		1998-2003	
PROJECT	Probability	Rank	Probability	Rank	Probability	Rank	Probability	Rank
LNG Plant	.04	4	.15	3	.00	4	.00	5
Ammonia/Urea Plant	.13	2	.17	2	.01	3	.00	5
Air Separation Plant	.00	6	.00	6	.05	2	.06	2
Chieftain Pipeline	.05	3	.10	4	.00	4	.00	5
Sawmill	.21	1	.25	1	.00	4	.00	5
Copper Smelter	.00	6	.00	6	.00	4	.00	5
Alberta/Fluor Pipeline	.00	6	.00	6	.05	2	.10	1
Steel Mill	.00	6	.00	6	.05	2	.01	4
Lead/Zinc Smelter	.00	6	.00	6	.00	4	.00	5
Aluminum Smelter	.03	5	.06	5	.07	1	.04	3
Oil Pipeline Terminal	.00	6	.00	6	.00	4	.00	5

TABLE 4-8

RANKING OF PROJECTS BY MARGINAL PROBABILITY OF GO-AHEAD IN FIVE-YEAR BLOCKS (1983 - 2003): MEDIUM ECONOMIC GROWTH

PROJECT	1983-1987		1988-1992		1993-1997		1998-2003	
	Probability	Rank	Probability	Rank	Probability	Rank	Probability	Rank
LNG Plant	.24	4	.45	1	.00	7	.00	6
Ammonia/Urea Plant	.31	3	.31	2	.00	7	.00	6
Air Separation Plant	.04	6	.16	5	.19	1	.06	3
Chieftain Pipeline	.39	1	.22	4	.00	7	.00	6
Sawmill	.35	2	.25	3	.00	7	.00	6
Copper Smelter	.00	7	.12	6	.14	4	.06	3
Alberta/Fluor Pipeline	.00	7	.08	8	.17	2	.17	1
Steel Mill	.04	6	.12	6	.15	3	.07	2
Lead/Zinc Smelter	.08	5	.10	7	.10	5	.04	5
Aluminum Smelter	.08	5	.12	6	.10	5	.05	4
Oil Pipeline Terminal	.00	7	.01	9	.03	6	.04	5

TABLE 4-9

RANKING OF PROJECTS BY MARGINAL PROBABILITY OF GO-AHEAD IN FIVE-YEAR BLOCKS (1983 - 2003): HIGH ECONOMIC GROWTH

	1983-1987		1988-1992		1993-1997		1998-2003	
PROJECT	Probability	Rank	Probability	Rank	Probability	Rank	Probability	Rank
LNG Plant	.30	4	.60	1	.00	8	.00	7
Ammonia/Urea Plant	.55	2	.26	4	.00	8	.00	7
Air Separation Plant	.20	5	.31	2	.17	4	.09	3
Chieftain Pipeline	.51	3	.21	6	.00	8	.00	7
Sawmill	.56	1	.24	5	.00	8	.00	8
Copper Smelter	.12	6	.26	4	.19	3	.10	2
Alberta/Fluor Pipeline	.03	9	.15	8	.26	1	.22	1
Steel Mill	.07	8	.27	3	.21	2	.08	4
Lead/Zinc Smelter	.20	5	.22	5	.14	5	.06	5
Aluminum Smelter	.10	7	.18	7	.08	6	.03	6
Oil Pipeline Terminal	.00	10	.02	9	.05	7	.04	6

5.0 INDUSTRY-SPECIFIC SERVICE REQUIREMENTS

5.0 INDUSTRY-SPECIFIC SERVICE REQUIREMENTS

5.1 INTRODUCTION

Based on the process described in Section 4.0, eleven potential industrial developments were identified. These developments varied widely in the degree to which project details had been evaluated. Therefore, certain assumptions were necessary to define the requirements of these potential developments for purposes of this land demand study.

Each of the eleven developments are discussed below. Assumptions are stated regarding plant scale, site requirements and infrastructural needs. As far as possible, these assumptions were based on information supplied by the proponent, but in some cases the proponent was understandably reluctant to be quoted when the development had not passed the conceptual stage. Therefore, the following descriptions should only be considered as illustrative models appropriate for overall regional planning purposes.

5.2 DESCRIPTION OF POTENTIAL INDUSTRIAL DEVELOPMENTS

(a) Sawmill

Eurocan Pulp and Paper Co. Ltd. operates a pulp and paper mill southwest of Kitimat with a wharf on Kitimat Arm. The company is interested in establishing a sawmill with a capacity of 150 million board feet per year, which would employ up to 260 people. The preferred location is a 20 ha to 30 ha site north of the Service Centre. Access to port facilities would be necessary for the sawmill to serve the export market. A short rail spur and transmission line to the site would be required, with the sawmill having its own transformer. Other routine services such as water and sewers would be needed, as well as road access.

(b) Aluminum Smelter

The Aluminum Company of Canada Ltd. was Kitimat's first major industry. Its wharf on Kitimat Arm is used for importing raw materials and exporting products to foreign markets. Alcan has been considering the establishment of a new aluminum smelter in northwestern B.C. The Dubose site midway between Kitimat and Terrace, is one possible location. However, subsequent to the interviews conducted for this report, Alcan announced its plans to construct 2 smelters in the north, the first of which would be located in Vanderhoof.

A typical 170,000-t/year smelter would require close to 800 ha of land and could employ 750 people. A substantial water supply (roughly 1200 m^3/day) would be used for cooling water make-up, in addition to the personal use of water by the smelter labour force. Typical electricity requirements would be in the order of 300 MW. Rail service would be required to the site and the Kitimat-Terrace rail line would possibly require upgrading.

(c) Air Separation Plant

Canadian Liquid Air Ltd. has an air separation plant at Sand Hill, west of Kitimat. Further expansion or an additional plant would certainly be considered if future industrial developments in the area created an increased market for their liquid gas products. Possible users would include an LNG plant, petrochemical plant, metallurgical smelter, and steel mill. The preferred location for a new plant would be as close as possible to a major user, which could be supplied by a product pipeline. A small plant (100 t/day of liquid product) requires up to 4 ha, while an air separation plant to supply a steel mill requires 4 to 8 ha. The power requirement for a small plant is estimated at 3000 to 4000 kW. The cooling make-up water requirement is approximately 0.015 m^3/s.

(d) Ammonia/Urea Plant

Ocelot Industries Ltd. has a methanol plant on the west side of the Kitimat River, south of the Kitimat townsite. Support facilities include a 1.7 km long causeway to a shipping terminal on Kitimat Arm. The company proposes to add a 998 t/day ammonia plant and 1,088 t/day urea plant on an adjacent lot immediately south of the existing facilities. The new complex will occupy approximately 14 ha and will utilize the existing right-of-way, causeway and wharf structures. An elevated conveyor system, and ammonia product and vapour return pipelines, 3.8 km in length, would be constructed between the site and the wharf.

(e) LNG Plant

Several groups have proposed to the B.C. Government to develop an LNG (liquefied natural gas) liquefaction plant and export facility to market natural gas from B.C. and Alberta to Asia. The RIM GAS consortium, of which Petro Canada is a member, named Bish Cove as its preferred location for a plant processing 8.7 million m^3/day of natural gas. Such a development would involve about 70 permanent jobs and would require almost 400 ha, including 70 ha for the plant itself and the remainder to serve as a buffer zone for aesthetic and safety reasons. The facility would have to be located adjacent to deep water and would require road access, a gas pipeline, and about 30 MW of electricity. If cooling towers are used, a freshwater supply of 0.16 m^3/s would be required, whereas only 0.0035 m^3/s would be necessary if a seawater cooling system were used.

(f) Oil Pipeline Terminal

In the mid-1970's, Kitimat Pipe Line Ltd. investigated a proposed oil pipeline to an export facility consisting of access roads, pipelines, pier and docking facilities, storage tanks and office buildings. The proposed tanker site was about 2 km south of the Alcan smelter, on the west side of Kitimat Arm, encompassing a site about 2 km along the shore and 0.5 km inland. However the developable land requirement would be much smaller, perhaps 25 ha. The requirements for electricity and fresh water would not be high, but these services and road access would have to be extended from the vicinity of the Alcan wharf.

(g) Coal Slurry Pipeline

Chieftain Development Co. Ltd. is conducting prefeasibility studies of a coal slurry pipeline terminating on the B.C. coast. Such a development would have site requirements similar to those given below for the pipeline proposed by the Alberta Government.

In 1981, the Government of Alberta and Fluor Canada Ltd. completed a feasibility study for a coal slurry pipeline from western Canada sources to a west coast port facility for export to foreign markets. The candidate site for the marine loading facility was near Wathlsto Creek, chosen for its advantages in terms of pipeline access, carrier access, land availability, and geotechnical and socio-economic factors. The terminal facilities would occupy about 12 to 29 ha and would include slurry storage ponds, as well as facilities for slurry dewatering, water treatment, product storage and carrier loading (for 250,000 DWT carriers). Wastewater would be disposed of in Kitimat Arm.

(h) Lead/Zinc Smelter

The B.C. Ministry of Industry and Small Business Development (MISBD) has supplied information developed by Wright Engineers and H.N. Halvorson Consultants to evaluate a metallurgical complex in B.C. There are numerous combinations of processes and production scales which could be used in such a complex. For this analysis, a plant to produce 300,000 t/year zinc and 150,000 t/year lead is assumed. For the plant, a 250 ha site would be required with access to tidewater as well as road and rail lines. The water requirement is roughly 0.5 m^3/s for power cooling and process make-up and cooling. The power required for a pressure leach process is estimated at 220 MW. The Wedeene site was preferred over the Dubose site because of proximity to the port and existing railway, and distance from the Terrace airport (where air quality/visibility would be important factors).

(i) Steel Mill

During the mid-1970's, extensive studies were carried out by the B.C. government and NKK of Japan, proposing a 2,000,000-t/year blast furnace and basic oxygen furnace steel mill at the Wedeene site. Such a steel mill requires close to 800 ha, including surrounding buffer areas, as well as road access, rail lines, 140 million m^3/year of natural gas, about 100 MW of electricity, and 40,000 m^3/day of fresh water. Close to 4,000 people would be employed in this type of integrated steel mill. Iron ore would be imported by ship and the steel product would be exported by ship as well, so access to a deepwater site is considered essential.

(j) Copper Smelter

The B.C. Ministry of Industry and Small Business Development has encouraged interest in development of a copper smelter in the province. The economic size of a conventional copper smelter is about 100,000 t/year. A preferred site would be on tidewater so that products could be shipped by sea; alternatively, products could be transported eastward by rail. The power requirements of a copper smelter have been estimated in the order of 40 to 60 MW. The site requirements of a copper smelter would vary widely with the type of technology used. (The 50-year-old Flin Flon smelter of Hudson Bay Mining and Smelting Company is crowded onto less than 5 ha.) For this study a land requirement of 30 ha is assumed.

5.3 SUMMARY OF REQUIREMENTS

A central objective of this study was to address the needs of industries that have indicated an interest in locating in the Kitimat-Terrace Corridor. However, these needs vary greatly in magnitude depending upon the scale of the development and technology used in the industrial process. Thus, the actual area consumed by these developments does not necessarily translate into corresponding infrastructural demands.

Manpower requirements to operate these plants could vary from 70 employees for the LNG plant which would occupy 400 ha to 260 employees for a sawmill occupying 20 to 30 ha, to 2,400 employees working at an aluminum smelter occupying 800 ha. These employment requirements might also decrease as technological developments streamline the industrial process.

Thus, an employee/land consumption ratio cannot be applied to these developments.

Road access is necessary to all developments. However, the key factor determining the quality (width, finish, bearing capacity) is the proposed road use, whether by employees or for materials handling purposes. The necessity of rail access again depends upon the materials handling requirements of each plant. For example, for the LNG plant and the pipeline proposals, given the nature of incoming feedstock to the site and export via ship from the site, a rail service would be superfluous.

On the other hand, projects whose initiation is entirely dependent on the development of other downstream industries that would create the necessary demand to warrant development, may benefit from the infrastructure developed by the downstream industry. Port facilities are generally required by all of the export-oriented industries. Again, the variable quantities of production will determine the frequency of port use, and thereby affect the decision of whether to construct additional private harbour facilities, or to make arrangements (if possible), for use of one of the three existing wharves.

Water requirements are dependent upon the type of technology used in the industrial process design. Minimum water requirements would be for employee use only. Another factor is the quality of water required. The variety of water needs is apparent from the following figures. For an aluminum smelter of 150,000 t/year capacity, 10.5 m^3/s are required for makeup water. A lead/zinc smelter producing 300,000 t/year of zinc would need 0.5 m^3/s. A steel mill (2,000,000 t/year) would need 0.46 m^3/s. A more striking example of the variation was given by the LNG plant proponent, where a requirement of 0.16 m^3/s was given on the assumption of cooling towers being a part of the process. Conversely, if the process is designed so that sea-water cooling water is used, this requirement would only be 0.0035 m^3/s.

The electrical requirements of each industry can be defined in terms of overall quantity required. This could affect the bearing capacity of the B.C. Hydro grid system. The type of service, whether continuous or discontinuous, could affect the mode of supply. Another factor affecting electrical needs is whether the design includes diesel engines on-site that would satisfy internal requirements. This, plus process differences, accounts partially for the difference in demand between the LNG facility for 30 MW, and the lead/zinc smelter for 225 MW. The air separation plant would consume 3,000 to 4,000 kW/year; whereas the steel mill requires 100 MW and the copper smelter (100,000 t/year) would require approximately 40 to 60 MW.

The supply of natural gas to the industrial sites poses another problem, that of distinguishing between feedstock required to produce the product, and fuel required to proceed with the process. If feedstock is required, then, in all likelihood, a separate gas line would be required to support this demand.

Of the eleven projects, two of them (the coal slurry pipelines) entail competing proposals for near identical purposes. In Section 4.0 they were evaluated as separate projects because, given differences in sponsorship, financing, technical back-up and specific concepts, their respective probabilities of occurrence were different.

However, as it is clear that these two projects are mutually exclusive, only one of them need be considered in an assessment of aggregate industrial land demand. Therefore, in assessing one coal slurry pipeline plus the nine remaining projects, Table 5-1 lists their total conceivable land demand.

Depending upon variations in site layout, it is evident that a total of approximately 2,400 ha would be required to meet the aggregate demand exclusive of safety zones, off-site services and rights-of-way (i.e. for road, rail, power and other utilities). In a sense 2,436 ha represents an upper limit, for the realization of all 10 types of projects within the study area is, for practical purposes, beyond the realm of realistic expectation.

TABLE 5-1

PROJECTED INDUSTRIAL LAND REQUIREMENTS TO SATISFY ALL PROSPECTIVE PROJECTS

Projects	Land Demand (ha)
(a) Sawmill	20-30
(b) Aluminum Smelter	800
(c) Air Separation Plant	4-8
(d) Ammonia/Urea Plant	14
(e) LNG Plant	400
(f) Oil Pipeline Terminal	25
(g) Coal Slurry Pipeline	12-29
(h) Lead/Zinc Smelter	300
(i) Steel Mill	800
(j) Copper Smelter	30
TOTAL:	2,405 - 2,436 ha

6.0 PROJECTED DEVELOPMENT SCENARIOS

6.0 PROJECTED DEVELOPMENT SCENARIOS

6.1 INTRODUCTION

This section completes the land demand study. It brings together the key findings in the preceding analyses carried out in Sections 2.0 through 5.0. In sifting through the data, an attempt is made to construct most likely development scenarios under three growth projections.

Attendant demands for land, services and a development infrastructure associated with each scenario have already been highlighted. In so doing, some of the key secondary and tertiary implications arising from the realization of the projected projects were delineated. This in turn can provide a basis for future policy making to mitigate potential land-use conflicts, socio-economic and environmental concerns.

However, in interpreting this section of the report, two notes of caution are warranted. First, the terms of reference for this study have been necessarily narrow. The complexity of the issues addressed, and the many independent variables which interact with one another require that the primary focus to this analysis not be diluted through tangental studies into subsidiary considerations.

Environmental concerns related to these projects need to be investigated in detail. Social impacts may be significant. Cumulative effects connected with the implementation of several projects simultaneously may seriously strain the capacity of existing services and infrastructure. All of these issues are important. They may influence future decision making regarding land allocation in the Corridor. Yet each of these are beyond the terms of reference for this study.

The second note of caution relates to the quality of the data itself. As noted elsewhere in the study, it has often been necessary to make broad assumptions in relation to various aspects of those projects which have yet to be clearly defined. In some instances, such as the ammonia and urea plant or the Bish Cove LNG plant, detailed studies have already been undertaken. In many others, even the most cursory investigations at the pre-feasibility level have yet to be completed.

Hence a degree of "crystal balling" has been necessary. Future studies of a more detailed nature, supplemented by field verification may lead to significant revisions of our conclusions, and of the underlying assumptions upon which they are predicated. Nonetheless, given the available data base, and the constraints imposed by time and budget, it is believed that the scenarios depicted below are the most accurate possible at this time.

6.2 THE LOW DEMAND SCENARIO

6.2.1 The 1983 - 1992 Period

Under a low growth scenario it is assumed that the average annual increase in the provincial GDP would range from a negative value to no more than +2.9 percent. Under this scenario, none of the projects have a probability of occurrence exceeding 46 percent. With the Sawmill project set at this upper limit of probability (see Table 4-7), the next most likely projects in descending order are: the Ammonia/Urea Plant (30%); the LNG Plant (19%); the Chieftain Coal Slurry Pipeline (15%); the expanded Celanese Methanol Port Terminal (10%); and, finally a new Aluminum Smelter listed at 9 percent.

The probabilities suggest that it is rather unlikely that more than two of the projects will proceed. For example, the probability of both the Sawmill and Ammonia/Urea Plant proceeding is .46 X .30 = .14. When the next ranking project is added to this (the LNG Plant), their joint probability is subsequently reduced to 0.03 (assuming that the projects are independent of one another and are not mutually exclusive).

From a regional planning perspective, the implications are clear. In a low growth economy, one need only plan for one of these projects although prudence would suggest that contingency planning be undertaken for perhaps two of them. As the total land demand for both the Sawmill and the Ammonia/Urea Plant has an upper limit of 44 ha, the incremental effect on developable parcels is small.

The LNG plant would require 400 ha. But as the preferred site on Bish Cove is beyond the traditional confines of the the Terrace-Kitimat Industrial Corridor, and as it is situated in an area of few potential land-use conflicts the net effect of this project on the availability of industrial land is projected to be minimal.

6.2.2 The 1993 - 2003 Period

Within this 10 year time frame, only 3 projects have a probability of occurrence exceeding 10 percent. These are the Coal Slurry Pipeline advocated by the Alberta government and Fluor Canada Ltd. (15%), the Aluminum Smelter (11%) and the Air Separation Plant (11%). The joint probability of the Slurry Pipeline and one of the remaining two projects proceeding is 1.65%.

The cumulative land demand associated with the 3 projects ranges from 816 to 837 ha. If one adds to this the 44 ha required for the Sawmill and Ammonia/Urea Plant, it is evident that within the entire 20 year low growth scenario, it is highly unlikely that more than 881 ha would be required to accommodate all of the most likely projected projects. This represents only 8.2% of the total area currently available for industrial development.

6.3 THE MEDIUM DEMAND SCENARIO

6.3.1 The 1983 - 1992 Period

In the medium demand scenario, it is assumed that the average annual increase in the provincial GDP ranges from +3.0 to +5.9 percent.

In the first decade under review, four projects have probabilities of occurrence exceeding 0.25. These are listed below in descending order.

Project	Probability of Occurrence
LNG Plant	0.69
Ammonia/Urea Plant	0.62
Chieftain Pipeline	0.61
Sawmill	0.60

The joint probability of the first two occurring is 0.428, of the top three, 0.261; and of all four, 0.156. The maximum cumulative land demand for all four projects is 473 ha or 4.4% of that currently available.

6.3.2 The 1993 - 2003 Period

In this period only four projects have probabilities exceeding 0.20. In descending order they are:

Project	Probability of Occurrence
Alberta/Fluor Coal Slurry Pipeline	0.34
Air Separation Plant	0.25
Steel Mill	0.22
Copper Smelter	0.20

The joint probability of the first two is 0.085, and of the first three, 0.019. (This does not take into consideration the mutual exclusivity of the pipeline projects.) Cumulative land demand for the top two projects are a maximum of 37 ha (vs. 867 ha for all four).

If one aggregates the projected land demand occurring from all of the 7 most likely projects delineated in the 20 year medium demand period, it amounts to a maximum 1,311 ha or 12.2% of that projected as being currently available.

6.4 THE HIGH DEMAND SCENARIO

6.4.1 The 1983 - 1992 Period

This scenario assumes a level of growth in the provincial GDP of greater than +6.0 percent, a condition which last occurred in 1974. As this high demand projection assumes that such rapid expansion of the economy would continue uninterrupted for at least the ten year sub-periods under review, the likelihood of this condition materializing is small.

Nonetheless, cumulative land demands associated with various joint probabilities have been determined. Given the unprecedented growth which is assumed to occur in this context, 5 projects have probabilities exceeding 0.50. These are:

Project	Probability of Occurrence
LNG Plant	0.90
Ammonia/Urea Plant	0.81
Sawmill	0.80
Chieftain Coal Slurry Pipeline	0.72
Air Separation Plant	0.51

The joint probability of the first two occurring is 0.729, and of the first three, 0.583. When the fourth project is added, this reduces to 0.420 and when all five are considered the probability is 0.214.

The maximum aggregate land demand connected with all five projects is 481 ha.

6.4.2 The 1993 - 2003 Period

In this period, only four projects have probabilities exceeding 0.25. In descending order these are listed below.

Project	Probability of Occurrence
Alberta Fluor Pipeline	0.48
Copper Smelter	0.29
Steel Mill	0.29
Air Separation Plant	0.26

The joint probability of the first two projects is 0.139; of the first three, 0.040; and of all four, 0.010. Aggregate land demands comprise a maximum of 867 ha representing 8.1% of that potentially available.

When the most likely projects in the 1983-1992 high demand period are added in (net of the competing coal slurry pipeline), the total conceivable demand rises to 1,319 ha or 12.3 percent of the total available land.

6.5 LAND-USE CONFLICTS

Table 4-2 indicated that as much as 2,436 ha would be required to meet the total land demand connected with all 10 types of projects. Of the 11,931 ha within the 21 development sites, it has been noted that 10,715 ha are currently available (see Table 3-1).

This, however, needs to be qualified. Some of the land falling within the 10,715 ha total is presently restricted to agricultural land use. A total of 1,595 ha, representing 14.9% of that available, falls within this category. Such restrictions occur on the Thunderbird, Terrace Airport, Terrace North and Copper City Flats sites.

In addition, Indian Reserves occupy another 170 ha of potential industrial lands in the South Corridor Region.

Both the ALR and Indian Reserve lands were included in the original land designation exercise because their currrent status does not irrevocably preclude future industrial use. Any decisions regarding the use of land within an ALR for purposes other than farm use lie within the jurisdiction of the Provincial Agricultural Land Commission. Use of Indian Reserve Lands which are administered by local Bands are open to negotiation.

Similarly, much discussion has taken place regarding the merits of establishing a new Provincial Forest on lands within the Corridor. The issues surrounding this matter are policy related, and are beyond the scope of this study. However, it should be noted that the Forestry Act (1978) under Section 5(8) makes provision for the option of removing land from Provincial Forest status if such a use would result in "a greater contribution to the social and economic welfare of the Province".

The establishment of the forest would (potentially though not irrevocably) remove 857 ha from the 1,300 ha Wedeene Site and 3,089 ha from the 3,300 ha Dubose Site. Combined, this represents 36.8% of the aggregate lands currently available.

Figures 6-1 through 6-3 superimpose the ALR, Indian Reserve and proposed Provincial Forest boundaries over the projected 21 sites. Table 6-1 delineates the net effect resulting from the loss of such lands.

As the total conceivable project demand (net of off-site services and rights-of-way) is 2,405 to 2,436 ha, while that unencumbered by reserves and the proposed forest is 5,004 ha, it is evident that almost all projected industrial land demands in the study area can be met, without compromising the fundamental integrity of current or projected land-use options. However, additional studies would be necessary to assess the neighbourhood effects (for eg., noise, aesthetics air pollution, etc.) of each development proposal locating on any of the remaining identified sites.

The only exceptions occur in connection with the two largest projects. The steel mill and the Aluminum Smelter would each require 800 ha parcels. An analysis of Table 3-1 as modified by the right column in Table 6-1 indicates that no 800 ha parcels would remain in the study area if the reserve and the proposed forest were to exclude prospective industrial land uses.

To accommodate these two projects within the study area, some lands within the existing and/or proposed reserves may have to be dedicated to industrial use. However, the total

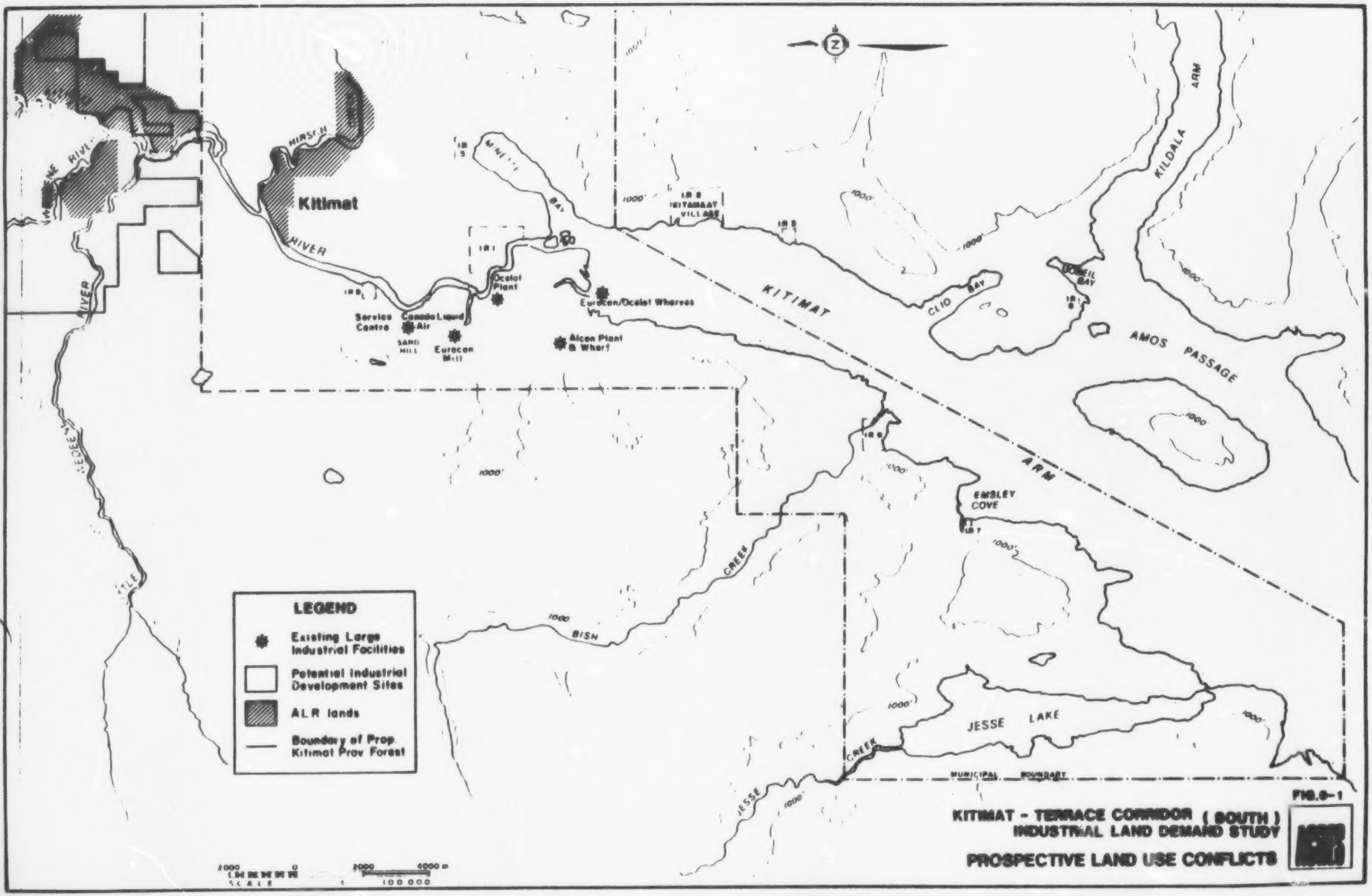
Kitimat
HIRSCH
RIVER
KITIMAT
ARM
KILDALA
ARM
AMOS PASSAGE
CLIO BAY
MINETTE BAY
EMSLEY COVE
JESSE LAKE
JESSE
CREEK
BISH
CREEK
RIVER
WEDEENE RIVER
KITAMAAT VILLAGE
IR 2
IR 1
IR 3
IR 5
IR 6
IR 7
IR 9
1000'
MUNICIPAL BOUNDARY
Service Centre
Canada Liquid Air
Ocelot Plant
Eurocan/Ocelot Wharves
Alcan Plant & Wharf
Eurocan Mill
SAND HILL
LEGEND
Existing Large Industrial Facilities
Potential Industrial Development Sites
ALR lands
Boundary of Prop. Kitimat Prov Forest
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.9-1

KITIMAT - TERRACE CORRIDOR (SOUTH)
INDUSTRIAL LAND DEMAND STUDY

PROSPECTIVE LAND USE CONFLICTS

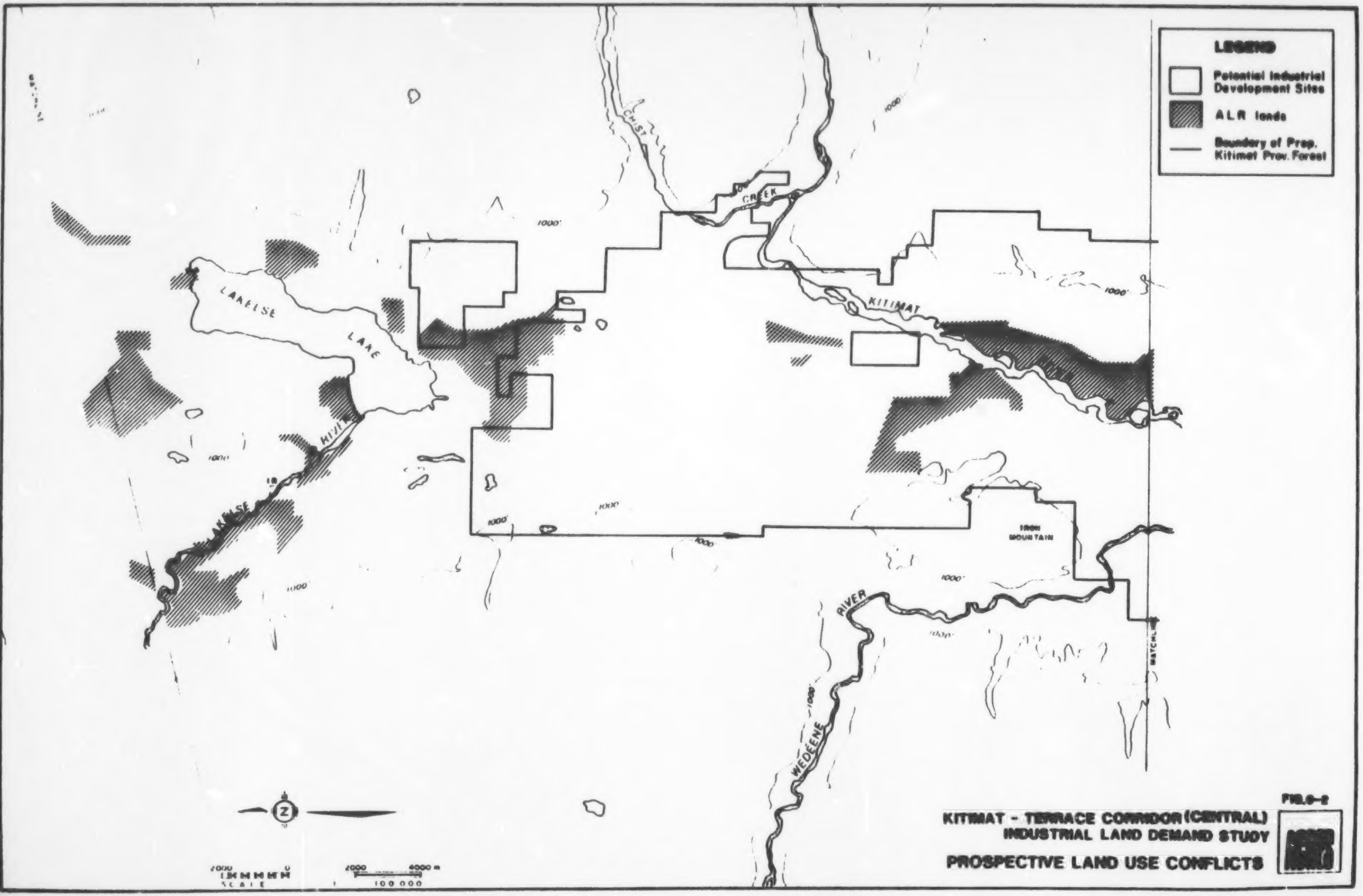
LEGEND
☐ Potential Industrial Development Sites
▨ A L R lands
— Boundary of Prop. Kitimat Prov. Forest
CHIST CREEK
KITIMAT
LAKELSE LAKE
LAKELSE
IRON MOUNTAIN
WEDEENE RIVER
1000'
Z
2000 0 2000 4000 m
SCALE 1 : 100 000

FIG.6-2

KITIMAT - TERRACE CORRIDOR (CENTRAL)
INDUSTRIAL LAND DEMAND STUDY

PROSPECTIVE LAND USE CONFLICTS

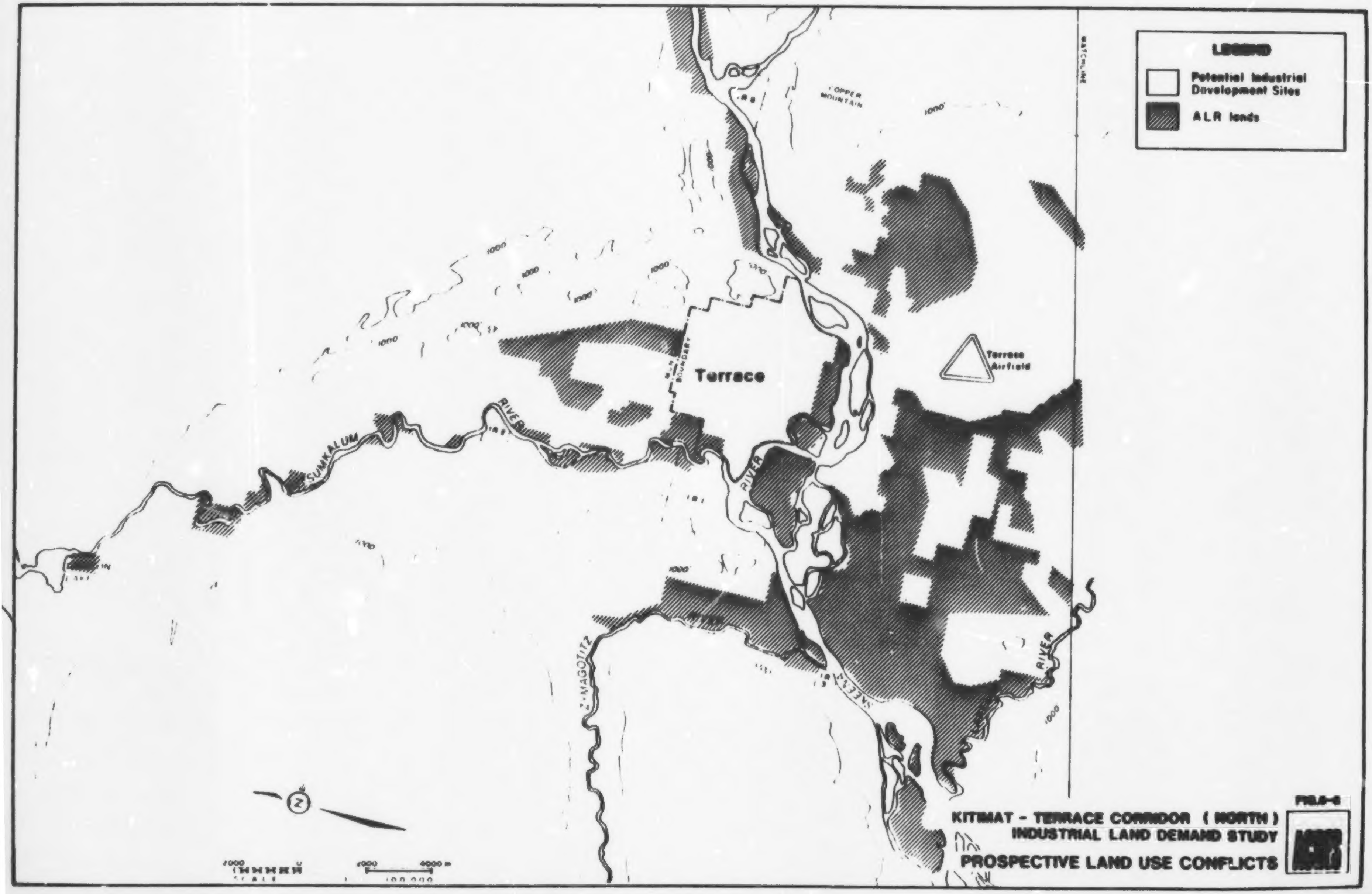
LEGEND
▢ Potential Industrial Development Sites
▨ ALR lands
MATCHLINE
COPPER MOUNTAIN
1000
Terrace Airfield
Terrace
BOUNDARY
SUMKALUM
RIVER
RIVER
SKEENA
RIVER
ZYMAGOTITZ
N
SCALE
2000
4000 m

FIG.6-6

KITIMAT - TERRACE CORRIDOR (NORTH)
INDUSTRIAL LAND DEMAND STUDY

PROSPECTIVE LAND USE CONFLICTS

incremental requirement may be small. For example, only 50 ha would need to be alienated from the Terrace North ALR in order to accommodate one of the 800 ha projects.

Alternatively, it may be possible to assemble a large enough property from abutting parcels. For example, if the 600 ha on the Northern Site were added to the 443 remaining ha on the Wedeene Site, the combined 1,043 ha parcel would be large enough to accommodate any of the projected developments.

Other locations where the assembly of parcels is possible are delineated in Appendix A. Also, it should be noted that the 19 of the 21 selected industrial sites represent prime developable areas. If required, additional lands adjacent to these indicated could be incorporated within the designated parcels. Such areas may be less favourable due to terrain or other considerations. However, at a price, almost any parcel is developable.

The 10,715 ha within the 21 sites does not represent an upper limit but rather only the better, or in a sense, the economically developable lands. If the more marginal but still developable zones were included, the total conceivable area for industrial use might double. For reasons of practicality, the analysis was not structured to define what is theoretically possible, but simply to concentrate on the most favoured potential locations. Still, the boundaries of the 19 sites are not immutable. Modifications can be made to many of them in order to accommodate specific project needs.

Most importantly, the probability of requiring sufficient land to meet every conceivable industrial demand is extremely remote. Consequently, it would appear that the Kitimat-Terrace Corridor can continue to function well into the foreseeable future, as both an industrial centre and a production area for agricultural produce and tree crops.

TABLE 6-1

SITES AFFECTED BY AGRICULTURAL LAND RESERVES, INDIAN RESERVES OR THE PROPOSED KITIMAT PROVINCIAL FOREST

Site	Potential Available Area (ha)	Remaining Area Net of Reserves and Proposed Forest (ha)
DOUGLAS CHANNEL SITES		
Emsley Cove	120	110
Bish Creek	100	20
Kitamaat	100	20
SOUTH CORRIDOR SITE		
Wedeene	1,300	443
NORTH CORRIDOR SITES		
Dubose	3,300	211
Thunderbird	1,000	500
Terrace Airport	400	380
Terrace North	1,500	750
Copper City Flats	325	0
		2,434 ha

TOTAL AREA POTENTIALLY LOST: 5,711 ha or 53.3% of total available area (10,715 ha)

TOTAL AREA REMAINING: 5,004 ha

APPENDIX A - CHARACTERISTICS OF POTENTIAL INDUSTRIAL SITES IN THE KITIMAT-TERRACE CORRIDOR

MISKATLA INLET SITE

PARCEL DESCRIPTION

680 ha site, irregularly rectangular in shape. Dimensions approximately 6.4 km N-S by 1.1 km E-W.

LOCATION

26 km SSW of Kitimat City Centre. Occupies peninsula separating Miskatla Inlet and Jesse Lake on W side of Kitimat Arm.

BOUNDARIES

Mountainous terrain to N and S, Miskatla Inlet to W, and Jesse Lake and steeply mountainous terrain to northern and southern portions of E boundary, respectively.

TERRAIN CONDITIONS

Central portion at elevation of approximately 60-120 m; generally slopes to W toward sea level at Miskatla Inlet boundary, approximately sea level at Jesse Lake boundary. Not situated on any major floodplain. Some outcrops visible; base material may be suitable for heavy industrial foundations.[6] Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site; provides direct tidewater access, sheltered anchorage in 20-40 m water on both Miskatla Inlet to W and Jesse Lake to E.[1] No existing road or rail access; proposed on-site road and rail links N to Kitimat IUTC and Terrace also to serve Harbour West, Bish Creek and Emsley Cove sites to N. Probable transportation route alignments either to Jesse Falls (southern portion of site) or inland around N end of Jesse Lake.[5] Site designated as southern terminus for proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor). Approximately 28 km by water from Kitimat Arm area.

UTILITIES

No existing on-site utilities. Gas and electricity proposed to be extended S from Kitimat IUTC via Harbour West, Bish Creek and Emsley Cove sites. Fresh water could be provided by Jesse Lake to W, preliminary study (1959) indicates capability to provide 16 cms if dammed.[6]

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Low archaeological potential over entire site, no I.R.'s within site boundaries. Potential environmental and fisheries conflicts associated with damming of Jesse Lake. No other potential conflicts identified.

POTENTIAL USERS

Studied as location for steel mill, considered for pulp/paper mill development.

Sources: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase 1 (R20-6-1), not dated.

District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase II, 1977.

EMSLEY COVE SITE

PARCEL DESCRIPTION

120 ha site, irregularly rectangular in shape. Dimensions approximately 0.6 km N-S by 1.9 km E-W.

LOCATION

18 km SSW of Kitimat City Centre. Occupies Emsley Creek Estuary and areas to immediate N and W, on W side of Kitimat Arm directly N of I.R. #7.

BOUNDARIES

Relatively flat area along Emsley Creek inland to W, moderate slopes to N and E, and mountainous terrain and Emsley Cove to western and eastern portions of S boundary, respectively.

TERRAIN CONDITIONS

Relatively level site. Elevation generally 0-30 m, mild slope to SE toward Emsley Cove; sea level at Emsley Cove boundary. Not situated on any major river floodplain. Extensive deposits of soft marine clay underlying floodplain gravels of Emsley Creek, risk of slides.[2] Emsley Creek crosses southern portion of site W-E; possible necessity to divert, depending on nature and siting of development. Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site, provides direct tidewater access on Emsley Cove to S. No existing road or rail access; proposed on-site road and rail links N to Kitimat IUTC and Terrace also to serve Harbour West and Bish Creek sites to N and Miskatla Inlet site to S. Site located on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor). Approximately 16 km by water from Kitimat Port area.

UTILITIES

No existing on-site utilities. Gas and electricity proposed to be extended S from Kitimat IUTC via Harbour West and Bish Creek sites to N and terminate at Miskatla Inlet site to S. Fresh water available from Jesse lake to W or Kitimat River to N; Emsley Creek a potential minor fresh water source.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Low archaeological potential inland over majority of site, moderately high potential in foreshore areas; no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Studied by Eurocan as location for pulp mill, in mid-1960's by MacMillan Bloedel. Studied by Federal Dept. of Energy, Mines and Resources and B.C. Government for metallurgical processing, including potential lead/zinc smelter and steel mill development.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

BISH CREEK SITE

PARCEL DESCRIPTION

100 ha site, roughly rectangular in shape. Dimensions approximately 0.9 km N-S by 1.2 km E-W.

LOCATION

15 km SSW of Kitimat City Centre. Occupies Bish Creek Estuary and areas to immediate N, S and W, on W side of Kitimat Arm; majority of site located on I.R. #6.

BOUNDARIES

Mountainous terrain to W and E, Kitimat Arm to S, and relatively flat area along Bish Creek inland to N.

TERRAIN CONDITIONS

Relatively level site. Inland portion typically elevated approximately 30-75 m, generally slopes to S and SE toward Kitimat Arm; sea level at Kitimat Arm boundary. Not situated on any major river floodplain. Soil conditions probably but not confirmed to be similar to Emsley Cove site to S, characterized by floodplain gravels deposited over soft marine clay with risk of slides.[10] Bish Creek crosses central portion of site W-E; probable necessity to divert, depending on nature and siting of development. Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site, provides direct tidewater access on Kitimat Arm to S. No existing road (road within 8 km distance) or rail access; proposed on-site road and rail links N to Kitimat IUTC and Terrace via Harbour West site to N also to serve Emsley Cove and Miskatla Inlet sites to S. Site located on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor). Approximately 12 km by water from Kitimat Port area.

UTILITIES

No existing on-site utilities. Gas and electricity proposed to be extended S from Kitimat IUTC via Harbour West site to N, also to serve Emsley Cove and Miskatla Inlet sites to S. Fresh water cab be provided by Jesse Lake to W or Kitimat River to N; Bish Creek a potential minor fresh water source.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Very high archaeological potential over entire site. Approximately 80% of site area within boundaries of I.R. #6, RIMGAS consortium successfully negotiated industrial use of portion of site situated on I.R. lands. Possible fisheries conflict associated with diversion of Bish Creek.

POTENTIAL USERS

Selected as location for liquefaction plant and terminal facilities for proposed RIMGAS LNG project, now indefinitely postponed. Under consideration by DOME as LNG liquefaction plant/terminal site.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

KITAMAAT SITE

PARCEL DESCRIPTION

100 ha site, irregularly rectangular in shape. Dimensions approximately 2.1 km N-S by 0.5 km E-W.

LOCATION

8 km S of Kitimat City Centre. Occupies Wathl Creek Estuary and inland areas to immediate N, S and E, on E side of Kitimat Arm; majority of site located on I.R. #2 (Kitamaat Village).

BOUNDARIES

Mountainous terrain to E and S, steeply mountainous terrain to N, and Kitimat Arm to W.

TERRAIN CONDITIONS

Relatively level site, particularly estuary and foreshore areas. Elevation varies from sea level at Kitimat Arm boundary to maximum of approximately 75 m through eastern portion of site; northern and southern portions generally slope to SW and NW, respectively, toward Kitimat Arm. Not situated on any major river floodplain. Wathl Creek crosses northern portion of site E-W; possible necessity to divert, depending on nature and siting of development. Majority of ground cover cleared from delta and surrounding inland areas for Kitamaat Village.

ACCESS AND TRANSPORTATION

Potential port site, provides direct tidewater access on Kitimat Arm to W. Existing road link from Kitamaat Village to Kitimat via Minette Bay Road presently unsuitable for industrial use.[9] Construction of proposed highway connecting Kitimat and Kemano via Kitamaat Village contingent upon development of known major copper deposit 48 km E of Kitimat.[5] No existing or proposed on-site rail access. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utility or materials handling corridor). Approximately 5 km by water from Kitimat Port area.

UTILITIES

Existing Kemano-Kitimat hydroelectric line crosses site; no existing or proposed on-site gas route. Fresh water can be provided by Robinson Lake Watershed Reserve to NW, Kitimat River to N or Dala River to SE; Wathl and Wathlsto Creeks potential minor fresh water sources.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Robinson Lake Watershed Reserve located approximately 5 km to NE. Moderately high archaeological potential over majority of site, approximately 80% of site area within boundaries of I.R. #2. Much of the best areas presently developed for residential, recreational and community use of Kitamaat Village, limiting potential for industrial sitings.[9] No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

No indication of development suitability specified for particular industries.

Source: Acres Consulting Services Limited. Kitimat Steel Mill Preliminary Site Selection Study, British Columbia Development Corporation, 1982.

WATHLSTO CREEK SITE

PARCEL DESCRIPTION

30 ha site (approximately), irregularly rectangular in shape. Dimensions approximately 2.1 km N-S by 0.2 km E-W. Potential to increase site area to approximately 100 ha by assembly of adjacent level areas to N.

LOCATION

12 km S of Kitimat City Centre. Occupies estuary and foreshore areas to immediate S of Wathlsto Creek and I.R. #3, on E side of Kitimat Arm.

BOUNDARIES

Mountainous terrain to E and S, I.R. #3 to N, and Kitimat River to W.

TERRAIN CONDITIONS

Moderate slope to W toward sea level at Kitimat Arm boundary from approximately 60 m elevation through eastern portion of site. Not situated on any major river floodplain. Geotechnical conditions likely to be suitable for industrial foundations.7 Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site, provides direct tidewater access on Kitimat Arm to W. No existing or proposed on-site road access; existing Minette Bay Road presently unsuitable for industrial use, terminates approximately 3 km N of site at Kitamaat Village.9 No existing or proposed on-site rail access. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities or materials handling corridor). Approximately 7 km by water from Kitimat Port area.

UTILITIES

No existing or proposed on-site utilities. Fresh water can be provided by Kitimat River to N or Dala river to SE; Wathlsto and Wathl Creeks potential minor fresh water sources.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Moderately high archaeological potential over majority of site, primarily in foreshore areas; no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Recently studied by Alberta Ministry of Energy and Natural Resources as location for coal slurry pipeline dewatering, storage and marine terminal facility.

Source: Fluor Canada Limited. Coal Slurry Pipeline Feasibility Study, Alberta Ministry of Energy and Natural Resources, November, 1981.

CLIO BAY SITE

PARCEL DESCRIPTION

150 ha site, roughly rectangular in shape. Dimensions approximately 3.2 km N-S by 0.7 km E-W.

LOCATION

17 km S of Kitimat City Centre. Occupies valley connecting Clio and Gobell Bays on E side of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W and E, Clio Bay to N, and Gobell Bay to S.

TERRAIN CONDITIONS

Relatively level site. Inland portion typically elevated 0-30 m, maximum elevation 38 m. Generally slopes to N toward sea level at Clio Bay boundary over northern portion, to S toward sea level at Gobell boundary over southern portion. Not situated on any major river floodplain. Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site, provides direct tidewater access on Clio Bay to N and Gobell Bay to S. No existing or proposed on-site road or rail access. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities or materials handling corridor). Approximately 13 km by water from Kitimat Port area.

UTILITIES

No existing or proposed on-site utilities. Fresh water could be provided by Dala or Falls Rivers to SE; Wathisto Creek a potential minor fresh water source.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Moderately high archaeological potential over majority of site, primarily in foreshore and immediate inland areas; no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Studied as alternative location for liquefaction plant and terminal facilities for proposed RIMGAS LNG project.

Source: Acres Consulting Services Limited. Kitimat Steel Mill Preliminary Site Selection Study, British Columbia Development Corporation, 1982.

DALA RIVER SITE

PARCEL DESCRIPTION

400 ha site, irregularly rectangular in shape. Dimensions approximately 5.4 km N-S by 1.0 km E-W.

LOCATION

22 km SE of Kitimat City Centre. Occupies Dala River estuary and inland valley to immediate N at head of Kildala Arm, a fjord extending from E side of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W and E, relatively flat area along Dala River inland to N, and Kildala Arm to S.

TERRAIN CONDITIONS

Relatively level site, particularly estuary and foreshore areas. Straddles Dala River, limiting potential industrial sitings especially through northern portion; majority situated on Dala River floodplain. Elevation varies from sea level at Kildala Arm boundary to approximately 100 m through northern portion of site; western and eastern portions generally slope to SE and SW, respectively, toward Dala River and Kildala Arm. Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Presently accessible solely by water. Potential port site, provides direct tidewater access on Kildala Arm to S. There is road access via a gravel road which is not of industry-use quality. No existing or proposed on-site rail access. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor). Approximately 30 km by water from Kitimat Port area.

UTILITIES

Existing Kemano-Kitimat hydroelectric line crosses southern portion of site, transformer station in SE corner. No existing or proposed on-site gas route. Fresh water can be provided by on-site Dala River.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Very high archaeological potential over majority of site, primarily in foreshore and immediate inland areas; moderately low potential further inland. No I.R.'s within site boundaries. Potential fisheries conflict associated with use of and proximity to Dala River, depending on nature and siting of industrial development. No other potential conflicts identified.

POTENTIAL USERS

No indication of development suitability specified for particular industries.

Source: Acres Consulting Services Limited. Kitimat Steel Mill Preliminary Site Selection Study, British Columbia Development Corporation, 1982.

HARBOUR WEST SITE

PARCEL DESCRIPTION

40 ha site , rectangularly shaped. Dimensions approximately 4.2 km N-S by 0.1 km E-W. Potential to extend further south, integrate with other proposed industrial sites.[6]

LOCATION

8 km SSW of Kitimat City Centre. Occupies narrow strip of foreshore at base of mountains lining W side of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W, Alcan Plant and Reserve site to N, Kitimat Arm to E, and additional narrow foreshore area to S.

TERRAIN CONDITIONS

Moderate slope to E toward sea level at Kitimat Arm boundary from maximum elevation of approximately 53 m at western site boundary. Includes 2.4 km long flat shelf averaging 214 m in width.[6] Three streams cross site W-E; possible necessity to divert some or all, depending on nature and siting of development. Bedrock generally exposed or within a few feet of surface in central and southern portions of site, northern portion characterized by deeper bedrock overlain by maximum of approximately 17 m loose glacial deposits and marine clay.[3] Natural ground cover largely intact.

ACCESS AND TRANSPORTATION

Potential port site, provides direct tidewater access on Kitimat Arm to E. Alcan Plant and Reserve site immediately to N, existing Alcan industrial road terminates at northern tip of site. Proposed on-site road and rail links N to Kitimat IUTC and Terrace also to serve Bish Creek, Emsley Cove and Miskatla Inlet sites to S. Difficult terrain may require 30 m right-of-way for rail extension, grades of more than 1% considered acceptable upper limit.[13] Site located on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor). Approximately 2 km by water from Kitimat Port area.

UTILITIES

No existing on-site utilities. Gas and electricity proposed to be extended S from Kitimat IUTC, also to serve Bish Creek, Emsley Cove and Miskatla Inlet sites to S. Fresh water can be provided by Kitimat River to NE; Anderson and Moore Creeks potential minor fresh water sources.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Moderately high archaeological potential over entire site, no I.R.'s within site boundaries. No significant fisheries conflicts identified.

POTENTIAL USES

Selected as location for tank farm/pumping station and terminal facilities for proposed Kitimat-Edmonton oil pipeline project, now indefinitely suspended. Previously considered for steel mill development. Property owned by Alcan, studied in detail by other developers for a variety of industrial uses.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

EUROCAN WHARF SITE

PARCEL DESCRIPTION
55 ha site, rectangularly shaped. Dimensions approximately 1.4 km N-S by 0.4 km E-W.

LOCATION
6 km SSW of Kitimat City Centre. Occupies central portion of intertidal zone in Kitimat Port area at head of Kitimat Arm.

BOUNDARIES
Alcan Plant and Reserve site to W, Harbour Back-Up site (largely undeveloped) to N, Harbour East site (undeveloped) to E, and Kitimat Arm to S.

TERRAIN CONDITIONS
Flat estuarine site. Intertidal flat area; elevation near sea level throughout, sea level at Kitimat Arm boundary to S. Entirely situated on Kitimat River 200 year floodplain. Pockets of uncleared timber in northern portion, generally limited ground cover over marsh.

ACCESS AND TRANSPORTATION
Existing tidewater and road access. Eurocan Terminal facility provides direct tidewater access on Kitimat Arm to S; road access to Eurocan Mill site approximately 3 km to N, IUTC sites to N and Harbour East site to E provided by Eurocan Industrial road. Proposed public road to connect with planned main N-S arterial through Kitimat IUTC and Terrace; centerline survey completed by Dept. of to link site with existing highway, alignment to parallel western boundary of Harbour Back-Up site immediately to N.10 Joint Alcan/Eurocan/Ocelot proposal for tidewater access industrial road through Harbour Back-Up site probable to cross eastern portion of site.9 No existing or proposed on-site rail access. Site located immediately E of proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES
Existing on-site electricity. No existing or proposed on-site gas. Fresh water available from Kitimat River.

POTENTIAL LAND USE CONFLICTS
No ALR's existing or proposed within site boundaries. Not presently nor proposed to be utilized as a park, recreational or residential area. Very high archaeological potential over entire site, no I.R.'s within site boundaries. No significant fisheries or other unresolved conflicts identified.

POTENTIAL USERS
Site currently utilized by deepwater ocean terminal handling materials related to Eurocan Pulp and Paper Mill, located approximately 3 km to N on Eurocan Mill site. Terminal facility includes berth, storage and waterlot (log storage) areas.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

HARBOUR EAST SITE

PARCEL DESCRIPTION

55 ha site, rectangularly shaped. Dimensions approximately 1.4 km N-S by 0.4 km E-W.

LOCATION

6 km SSW of Kitimat City Centre. Occupies eastern portion of intertidal zone in Kitimat Port area at head of Kitimat Arm.

BOUNDARIES

Eurocan Wharf site to W, Harbour Back-Up site (largely undeveloped) to N, and Kitimat Arm to E and S.

TERRAIN CONDITIONS

Flat estuarine site. Intertidal flat area; elevation near sea level throughout, sea level at Kitimat Arm boundary to E and S. Entirely situated on Kitimat River 200 year floodplain. Relatively low cost of development estimated at $8.5 million (1970) for 100 ha port with seven deep sea berths due to quantity of fill material available in Kitimat River delta.[6] Generally limited ground cover over marsh.

ACCESS AND TRANSPORTATION

Potential port site, provides direct tidewater access on Kitimat Arm to S. Existing road access to IUTC sites to N via Eurocan Industrial road. Proposed public road to connect with planned main N-S arterial through Kitimat IUTC and Terrace; centerline survey completed to link site with existing highway, alignment to parallel western boundary of Harbour Back-Up site immediately to N.[10] Joint Alcan/Eurocan/Ocelot proposal for tidewater access industrial road through Harbour Back-Up site probable to be situated adjacent to W boundary.[9] Proposed rail access to link site with existing mainline serving Eurocan Mill site approximately 3 km to N. Site located approximately 1 km E of proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing or proposed on-site utilities. Existing hydroelectric service at Eurocan Wharf site adjacent to W, existing gas route located approximately 2 km NW serving Alcan Plant and Reserve site. Fresh water can be provided by Kitimat River to NE.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Very high archaeological potential over entire site, no I.R.'s within site boundaries. No significant fisheries conflicts identified.

POTENTIAL USERS

Studied by B.C. Harbours Board (1977) as proposed location for general cargo terminal and ferry terminal.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

ALCAN RESERVE

PARCEL DESCRIPTION

445 ha site, roughly rectangular in shape. Dimensions approximately 5.0 km N-S by 0.9 km E-W.

LOCATION

4 km SW of Kitimat City Centre. Occupies portion of Kitimat River delta directly W of western extreme of Kitimat River floodplain, including western portion of intertidal zone in Kitimat Port area and narrow strip of foreshore at mountain border, at head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W, Eurocan Mill site to N, Kitimat Arm to S, and Harbour Back-Up site (largely undeveloped), Eurocan Wharf site and Kitimat Arm to northern, central and southern portions of E boundary, respectively.

TERRAIN CONDITIONS

Generally flat estuarine site, conditions vary N-S across site. Elevation near sea level through intertidal flat area in central portion, northern portion slightly elevated. Mild slope to E toward sea level at Kitimat Arm boundary from approximately 30 m elevation at western boundary through southern portion of site. Anderson and Moore Creeks cross site W-E through central portion. Majority of western and southern portions of site elevated slightly above Kitimat River 200-year floodplain level; eastern perimeter and much of northern portion situated within Kitimat River 200-year floodplain. Bedrock likely to be overlain by approximately 60 m of compressible silts and clays, 30 m of gravel and 0.6-6 m of organic material, consolidation of marine clay beneath existing Alcan plant facilities has resulted in large settlements.11,2 Pockets of uncleared timber through northern portion of site, limited ground cover over marshy terrain in central portion, foreshore area cleared through southern portion.

ACCESS AND TRANSPORTATION

Existing tidewater, road and rail access. Alcan terminal facility provides direct tidewater access on Kitimat Arm to E and S; road access to IUTC sites to N and to Eurocan Industrial road serving Eurocan Wharf and Harbour East sites to E provided by Alcan Industrial road, paralleling western site boundary. Proposed public road to connect with planned main N-S arterial through Kitimat IUTC and Terrace; southern terminus of existing highway at northern site boundary. Existing rail access crosses site N-S adjacent to eastern boundary. Site located on proposed Kitimat Valley IUTC (Industrial transportation, utilities and materials handling corridor).

UTILITIES

All utilities provided on-site. Existing hydroelectric line crosses southern portion of site, gas route parallels rail alignment along eastern site boundary. Fresh water can be provided by Kitimat River.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Very high archaeological potential through foreshore areas of site, low potential inland; no I.R.'s within site boundaries. No significant fisheries or other unresolved conflicts identified.

POTENTIAL USERS

Approximately 30% of site utilized by Alcan smelter and terminal facilities. Remaining 305 ha area, primarily in northern and eastern portions of site on Kitimat River floodplain, reserved by Alcan for expansion and/or reconstruction of smelters; potential to develop reserve area in future and extend terminal southward.10,5 Alcan has indicated potential availability of portion of reserve area for short term occupancy by other industrial users.10

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

HARBOUR BACK-UP SITE

PARCEL DESCRIPTION

180 ha site, rectangularly shaped. Dimensions approximately 2.2 km N-S by 0.9 km E-W. Approximately 30 ha in northern portion of site presently utilized by industrial uses and related access dedications, 150 ha remain potentially available for additional industrial development.9

LOCATION

3 km SSW of Kitimat City Centre. Occupies central portion of Kitimat River delta immediately N of intertidal zone and W of Kitimat River and I.R. #1, at head of Kitimat Arm.

BOUNDARIES

Alcan Plant and Reserve site to W, Eurocan Mill site to N, Kitimat River and greenbelt to E, and Eurocan Wharf site and Harbour East site (undeveloped) to western and eastern portions of S boundary, respectively.

TERRAIN CONDITIONS

Flat estuarine site. Immediately inland from intertidal area, elevation near sea level throughout. Entirely situated on Kitimat River 200 year floodplain. Considerable site preparation probably required due to extensive presence of watercourses on site, particularly through southern portion.10 Although foundation conditions anticipated to be broadly similar to those of Alcan smelter and Reserve site immediately to W, soil studies conducted on northern portion of site indicate that compressible silts and clays underlying Alcan site are here replaced by sands, silts and gravels deposited by Kitimat River.10,11 Ground cover generally uncleared timber over northern and central portions of site, limited ground cover over marsh in southern portion.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing road access to IUTC sites to N and Eurocan Wharf and Harbour East sites to S via Eurocan industrial road paralleling western site boundary. Proposed public road to connect with planned main N-S arterial through Kitimat IUTC and Terrace; centerline survey completed to link site with existing highway, alignment also to parallel western site boundary.10 Joint Alcan/Eurocan/Ocelot proposal for tidewater access industrial road to cross western portion of site.9 Proposed rail link to link site with existing mainline serving Eurocan Mill site immediately to N planned in conjunction with extension to Harbour East site immediately to S. Site located on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

Existing hydroelectric line crosses southern portion of site, existing gas route located approximately 1 km to W serves Alcan Plant and Reserve site. Fresh water can be provided by Kitimat River adjacent to eastern site boundary.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area; 150 m greenbelt on each side of Kitimat River. Very high archaeological potential over southern portion of site, moderate to low potential through northern and central portions; no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Studied as location for tank farm/pumping station and terminal facilities for proposed Kitimat-Edmonton oil pipeline project, now indefinitely suspended. Ocelot reportedly negotiating to acquire approximately 32 ha parcel in northern portion of site immediately S of existing Methanol plant.9

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

SANDHILL SITE

PARCEL DESCRIPTION

60 ha site (when fully quarried), triangular shape. Dimensions approximately 1.1 km each side.

LOCATION

3 km W of Kitimat City Centre. Occupies narrow area W of Kitimat River compressed between river and mountain border, approximately 5 km N of head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W, Service Centre site (partially developed) to N, Kitimat River and greenbelt to E, and Eurocan Mill site to S.

TERRAIN CONDITIONS

Presently unsuitable for industrial development; future site estimated to contain several million tonnes (over 15 million m3) of sand and gravel, can provide major fill resource for industrial development.5 Presence of approximately 185 m Sandhill compresses passage between Kitimat River and mountains lining W side of Kitimat Valley to approximately 200 m at narrowest point.9 Quarrying operations currently underway, rate of recession of hill suggests minimum of approximately 10-20 years until potential utilization as industrial site.9 Not situated on any major river floodplain; present site elevation well above Kitimat River 200 year floodplain, anticipated to remain elevated above floodplain level when fully quarried. Ground cover largely removed for quarrying operations.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing road and rail alignments cross SE corner of site, connect with IUTC sites to N and S. Proposed industrial road to link Kitimat Port area and Highway 16 through Terrace, via Kitimat Valley industrial sites. Proposed rail extensions to serve Harbour Back-Up and Harbour East sites in Kitimat Port area to S. Situated on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing on-site electricity, potential to extend from hydroelectric line crossing Eurocan Mill site adjacent to S or from Service Centre site adjacent to N. Existing gas route parallels road and rail alignments through SE corner of site. Fresh water can be provided by Kitimat River adjacent to eastern site boundary.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area; 150 m greenbelt on each side of Kitimat River. Situated adjacent to E boundary of Clague Mountain Municipal Park. Moderate to low archaeological site potential over entire site, no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

No indication of development suitability specified for particular industries.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

SERVICE CENTRE SITE

PARCEL DESCRIPTION

160 ha site, irregularly oval in shape. Dimensions approximately 2.1 km N-S by 0.8 km E-W. Approximately 40 ha presently utilized by retail, service and industrial uses, primarily clustered in SE corner of site; 10 ha area in NE corner tentatively reserved for rail marshalling yard.[5,10] Approximately 110 ha remain available for additional industrial development and service centre expansion.

LOCATION

3 km W of Kitimat City Centre. Occupies western portion of width of Kitimat River delta W of Kitimat River, at border of mountains lining W side of Kitimat Valley approximately 6 km N of head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W, northern site (undeveloped) to N, Sandhill site (undeveloped) to S, and Radley Park and Kitimat River and greenbelt to E.

TERRAIN CONDITIONS

Relatively level site, elevation less than 30 m throughout. Entirely situated within Kitimat River 200 year floodplain. Ground cover generally uncleared timber through northern portion, pockets of uncleared timber through southern portion, primarily to W.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing highway alignment crosses SE corner of site immediately W of Haisla Bridge, connects to Kitimat townsite and southern IUTC sites; existing Eurocan industrial road parallels western site boundary, connects to Eurocan Wharf and Harbour East sites via southern IUTC sites and to Northern and Wedeene sites to N. Proposed industrial road along western site boundary to link Kitimat Port area to Highway 16 through Terrace, via Kitimat Valley industrial sites. Additional on-site road network to be provided as required, depending on pattern of future development.[9] Existing rail route connecting Kitimat and Terrace via IUTC sites crosses central portion of site N-S. Situated on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

All utilities provided on-site; installed infrastructure includes electricity, gas, water, sanitary and storm sewer, telephone, and telecommunication service.[5] Fire protection and snow removal also available.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area; Radley Park adjacent to eastern boundary bordered by 150 m Kitimat River greenbelt. Situated adjacent to E boundary of Clague Mountain Municipal Park. Moderate to low archaeological potential over entire site, no I.R.'s within site boundaries. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Existing industrial/service park orientation, fully serviced sites available sized from 500 m^2 to 1.8 ha.[9] Suitable for industrial, service and retail uses; existing secondary and tertiary industries include auto service and sales, lumber yard, tire sales and repairs, machine shops and other workshops, laundromat, retail stores, restaurants, bakery and dairy.[10] No site-specific regulatory standards or development guidelines prescribed (e.g. atmospheric emissions standards, maximum noise levels), heavy industry concentration beginning to develop in NW corner of site.[9]

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

NORTHERN SITE

PARCEL DESCRIPTION

600 ha site, irregularly rectangular in shape. Dimensions approximately 3.5 km N-S by 1.7 km E-W. Potential to consolidate with 1,300 ha Wedeene site immediately to N for total assembly of approximately 1,900 ha.

LOCATION

4 km NW of Kitimat City Centre. Occupies western portion of width of Kitimat River delta W of Kitimat River, at border of mountains lining W side of Kitimat Valley approximately 8 km N of head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W, Wedeene site (undeveloped) to N, Service Centre site (partially developed) to S, and rail alignment and Kitimat River and greenbelt to southern and northern portions of E boundary, respectively.

TERRAIN CONDITIONS

Relatively level site; gently rolling terrain generally elevated 30-60 m, mild slope to S and SE toward Kitimat River boundary. Traversed by several creeks and gullies trending W-E; possible necessity to divert, depending on nature and siting of development. Not situated on any major river floodplain, with exception of extreme SE corner which is within the Kitimat River 200 year floodplain. Site appears to be underlain by uncertain depth of sand and gravel followed by approximately 60 m of marine silts and silty clays; bedrock exposed along western and southern portions of site.12 Substantial ground preparation probably required; industrial development likely to involve unusually difficult geotechnical problems with correspondingly high construction costs.12 Settlement on the order of 1.5-3.0 m probable to occur beneath concentrated loads and to continue for tens of years.12 Timber cover logged from majority of site.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing Eurocan industrial road parallels E site boundary, connects to Eurocan Wharf and Harbour East sites via southern IUTC sites and to Wedeene site to N. Proposed industrial road through western portion of site to link Kitimat Port area to Highway 16 through Terrace, via Kitimat Valley industrial sites. Proposed Wedeene Access Road to skirt Kitimat townsite, link planned industrial road to Highway 25, approximately 25 km to E along northern site boundary. Existing rail route connecting Kitimat and Terrace via IUTC sites parallels eastern site boundary through southern portion, crosses site N-S through northern portion; proposed extensions to serve Harbour Back-Up and Harbour East sites in Kitimat Port area to S. Situated on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

Existing hydroelectric line crosses central portion of site; existing gas route crosses western portion. Fresh water can be provided by Kitimat River adjacent to eastern site boundary.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries, small ALR on E side of Kitimat River approximately 1 km to E. Low archaeological potential over entire site, no I.R.'s within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area; 150 m greenbelt on each side of Kitimat River. Not under consideration for inclusion in proposed Kitimat Provincial Forest. Situated adjacent to E boundary of Clague Mountain Municipal Park. No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Proposed Kitimat-Edmonton oil pipeline alignment crosses northern portion of site, project now indefinitely suspended. Studied as location for steel mill by NKK-BC Study Team, unfavourable foundation conditions resulted in extension of study area to Wedeene site immediately to N.12

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

WEDEENE SITE

PARCEL DESCRIPTION

1,300 ha site, rectangularly shaped. Dimensions approximately 5.8 km N-S by 2.3 km E-W. Potential to consolidate with 600 ha Northern site immediately to S for total assembly of approximately 1,900 ha.

LOCATION

6 km N of Kitimat City Centre. Occupies western portion of Kitimat Valley W of Kitimat River, at border of mountains lining W side of Kitimat Valley approximately 12 km N of head of Kitimat Arm.

BOUNDARIES

Mountainous terrain to W, Wedeene River to N, relatively level terrain to E, and Northern site to S.

TERRAIN CONDITIONS

Relatively level site; generally elevated 60-90 m, mild slope to SE toward Kitimat River. Little Wedeene River crosses site W-E, influences industrial siting alternatives through central portion. Not situated on any major river floodplain, Little Wedeene River floodplain currently unmapped. Preliminary indications are that approximately 21 m sand and gravel is underlain by 15 m silty clay, depth to bedrock probably greater than 91 m.[12] Bedrock appears very deep and irregular in contour, steel pipes may be required for foundation support.[1] Bedrock knobs to elevation of 90 m in southern portion of site, swampy flats present in northern and southern portions.[1] Foundation conditions considered favourable for industrial development over southern portion of site, unfavourable over northern portion.[1] Timber cover logged from majority of site.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing Eurocan industrial road crosses eastern portion of site, connects with Eurocan Wharf and Harbour East sites via Kitimat IUTC sites. Proposed industrial road through western portion of site to link Kitimat Port area to Highway 16 through Terrace, via Kitimat Valley industrial sites. Proposed Wedeene Access Road to connect planned industrial road with Highway 25, approximately 5 km to E along southern site boundary. Existing rail route connecting Kitimat and Terrace via IUTC sites parallels eastern site boundary; proposed extensions to serve Harbour Back-Up and Harbour East sites in Kitimat Port area to S. Situated on proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing or proposed on-site utilities. Existing hydroelectric line and gas route located approximately 1 km to SE of SE corner of site. Fresh water can be provided on-site by Little Wedeene River; other potential sources include Wedeene River adjacent to N, Kitimat River to E or Jesse Lake approximately 30 km to S.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries, small ALR on E side of Little Wedeene River approximately 1 km to E. Low archaeological potential over entire site, except moderately low potential along Wedeene and Little Wedeene Rivers; no I.R.'s within site boundaries. Not presently or proposed to be utilized as a residential area. Northern, central and much of southern portions of site under consideration for inclusion in proposed Kitimat Provincial Forest. Situated adjacent to NE corner of Clague Mountain Municipal Park; air dispersion generally northward, occasionally southward in winter.[1] Potential fisheries conflict associated with use of Little Wedeene River. No other potential conflicts identified.

POTENTIAL USERS

Studied as location for steel mill by NKK - BC Study Team; suggested incorporating conveyor system up to 14 km in length to Kitimat Arm for raw materials transport, no river crossings required to Kitimat Port.[1] Studied by Federal Dept. of Energy, Mines and Resources and B.C. Government for metallurgical processing, including potential lead/zinc smelter and steel mill development. Tentatively selected for development of proposed Eurocan sawmill.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

DUBOSE SITE

PARCEL DESCRIPTION

3,300 ha site, irregularly shaped. Dimensions vary from 2.9-6.0 km N-S by 2.5-7.0 km E-W. Potential to increase site area to approximately 5,000 ha overall through assembly of adjacent level areas to N.[1]

LOCATION

22 km N of Kitimat City Centre; 24 km S of Terrace City Centre. Occupies western central portion of Kitimat-Terrace Corridor directly N of Iron Mountain and W of Kitimat river bend, approximately 27 km N of head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W and S, relatively level terrain to N, and Highway 25 to E.

TERRAIN CONDITIONS

Level gravel plateau, general elevation approximately 185 m.[8] Lone Wolf and Cecil Creeks cross SW corner of site; possible necessity to divert, depending on nature and siting of development. Not situated on any major river floodplain, foundation conditions may be favourable.[1] Timber cover logged from majority of site.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing Highway 25 alignment parallels E site boundary. Proposed industrial road through western portion of site to link Kitimat Port area to Highway 16 through Terrace, via Kitimat Valley industrial sites. Additional road link proposed to bisect central portion of site E-W, connect proposed industrial road with Highway 25. Existing rail route connecting Kitimat and Terrace via IUTC sites traverses western portion of site along western boundary, proposed extensions to serve Harbour Back-Up and Harbour East sites in Kitimat Port area to S. Site designated as northern terminus for proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing or proposed on-site utilities. Existing hydroelectric line and gas route located approximately 0.4 km E of eastern site boundary. Fresh water could be provided by Kitimat River to SE or pumped from Skeena River approximately 20 km to N;[1] Lone Wolf and Cecil Creeks potential minor fresh water sources.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries; small ALR's located approximately 1 km to N and SE of site. Low archaeological potential over entire site, except moderately low potential along Cecil Creek; no I.R.'s within site boundaries. Not presently or proposed to be utilized as a park, recreational or residential area. Entire site, with exception of small portion of SW corner, under consideration for inclusion in proposed Kitimat Provincial Forest; intensive silviculture programme underway in area. Situated immediately S of Lakelse Lake Regional Recreation Area; air dispersion generally northward, occasionally southward in winter.[1] Possible acidifying effects on Lakelse Lake, potential conflict with operation of Terrace-Kitimat Airport located approximately 18 km to N.[1] No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Proposed Kitimat-Edmonton oil pipeline alignment crosses SE corner of site, project now indefinitely suspended. Studied as alternate location for steel mill by NKK-BC Study Team. Suitable for development of major industrial park.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

THUNDERBIRD SITE

PARCEL DESCRIPTION

1,000 ha site, irregularly square in shape. Dimensions approximately 2.7 km N-S by 3.1 km E-W. Potential to increase site area to approximately 5,000 ha overall through assembly of surrounding level areas, including extensive floodplain areas to N and W, Terrace Airport site immediately to E, and areas to S and SE of Terrace Airport site.[1]

LOCATION

5.1 km S of Terrace City Centre. Occupies central location in northern portion of Kitimat-Terrace Corridor, approximately 2 km S of Skeena River and 49 km N of head of Kitimat Arm.

BOUNDARIES

Relatively level terrain to W and S, ALR's and Skeena River beyond to N, and Terrace Airport site (largely undeveloped) to E.

TERRAIN CONDITIONS

Relatively level gravel plateau, general elevation approximately 90-185 m.[8] Alwyn Creek crosses central portion of site W-E; possible necessity to divert, depending on nature and siting of development. Not situated on any major river floodplain, foundation conditions may be favourable.[1] Timber cover logged from portions of site.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing industrial road adjacent to eastern site boundary. Proposed industrial road to parallel northern boundary, planned to connect at western boundary with proposed road connection linking Kitimat Port area to Highway 16 through Terrace via Kitimat-Terrace Corridor industrial sites. Additional E-W alignments proposed along northern and southern site boundaries to connect planned Kitimat Port-Highway 16 route with Highway 25 to E. Existing rail route connecting Kitimat and Terrace via IUTC sites crosses central portion of site, connects to N with E-W line serving Prince Rupert and Prince George via Terrace. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor); Dubose site approximately 15 km to S designated as northern terminus.

UTILITIES

Existing hydroelectric line crosses southern portion of site; existing gas route adjacent to northern site boundary. Fresh water could be provided by Skeena River to N or Lakelse River to SW; Alwyn Creek a potential minor fresh water source.

POTENTIAL LAND USE CONFLICTS

Not presently or proposed to be utilized as a park , recreational or residential area. Low archaeological potential over entire site, except moderately low potential along Alwyn Creek; no I.R.'s within site boundaries. Not under consideration for inclusion in proposed Kitimat Provincial Forest; ALR covers over 50% of site area. Situated immediately N of Lakelse Lake Regional Recreation Area; air dispersion generally northward, occasionally southward in winter.[1] Possible acidifying effects on Lakelse Lake, potential conflict with operation of Terrace-Kitimat Airport adjacent to E.[1] No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

Studied as alternative location for steel mill by NKK-BC Study Team.

Source: District of Kitimat and Regional District of Kitimat-Stikine. Kitimat Valley: Industrial Areas Long Range Planning/Phase I (R20-6-1), not dated.

TERRACE AIRPORT SITE

PARCEL DESCRIPTION

1,331 ha site, irregularly shaped. Dimensions vary from 1.6-3.5 km N-S by 2.0-4.6 km E-W. Approximately 500 ha in central portion of site presently utilized by operating facilities of Terrace-Kitimat Airport, over 400 ha leased to 10 aviation-related tenants.[4] Approximately 400 ha remain available for industrial development. Potential to increase site area to approximately 5,000 ha overall through assembly of surrounding level areas, including extensive floodplain areas to W and NW, Thunderbird site to W, and adjacent areas to S and SE.[1]

LOCATION

3.3 km S of Terrace City Centre. Occupies central location in northern portion of Kitimat-Terrace Corridor approximately 1 km S of Skeena River and 51 km N of head of Kitimat Arm.

BOUNDARIES

Enclosed by Department of Transport Reserve boundaries; generally bounded by Skeena River to N, mountainous terrain to E, relatively level terrain to S, and Thunderbird site (undeveloped) and ALR to southern and northern portions of W boundary, respectively.

TERRAIN CONDITIONS

Relatively level gravel plateau; general elevation approximately 150-215 m, very mild slope toward Thunderbird site boundary to SW from mountainous terrain to E.[4] Not situated on any major river floodplain. Subsoil of coarse heavy stone gravel, provides good surface drainage; foundation conditions appear favourable.[4] Timber cover of second generation pine and hemlock over majority of site.[4]

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing Highway 25 linking Kitimat and Terrace along E side of Kitimat-Terrace Corridor crosses eastern portion of site, existing industrial road crosses western portion. Proposed E-W alignments adjacent to northern and southern site boundaries planned to connect Highway 25 with proposed Kitimat-Terrace industrial road to W; Kitimat-Terrace industrial road planned to link Kitimat Port area to Highway 16 through Terrace, via Kitimat Valley industrial sites. Existing rail route connecting Kitimat and Terrace via IUTC sites parallels western site boundary, skirts portion of northern boundary, connects to N with E-W line serving Prince Rupert and Prince George via Terrace. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

On-site 14,400 volt 2 phase electrical service to Terrace-Kitimat Airport, existing hydroelectric line adjacent to southern site boundary.[14] Existing gas route crosses NW and SE corners of site, sub-station on airport grounds.[4] Fresh water could be provided by Skeena River to N.

POTENTIAL LAND USE CONFLICTS

No ALR's existing or proposed within site boundaries, large ALR tracts immediately to SW and NE. Not presently or proposed to be utilized as a park, recreational or residential area. Low archaeological potential over entire site, no I.R.'s within site boundaries. Not under consideration for inclusion in proposed Kitimat Provincial Forest. Situated immediately N of Lakelse Lake Regional Recreation Reserve; air dispersion generally northward, occasionally southward in winter.[1] Possible acidifying effects on Lakelse lake, potential conflict with operation of on-site Terrace Airport.[1] No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

No indication of development suitability specified for particular industries. Required environmental compatibility with existing Terrace Airport operation suggests potential for light industrial and non-environmentally polluting heavy industry (e.g. rolling mill).[4] Land use plan for Airport and preliminary report on long-term development alternatives currently under preparation, completion expected in December, 1982.[4]

Source: Cook, T.W., Manager, Terrace-Kitimat Airport, for Transport Canada. Pers. Com., August and September, 1982.

TERRACE NORTH SITE

PARCEL DESCRIPTION

1,500 ha site, irregularly triangular in shape. Dimensions approximately 4.4 km N-S by 3.2 km E-W.

LOCATION

4.2 km NW of Terrace City Centre. Occupies majority of width of southern portion of Kitsumkalum Valley to E of Kitsumkalum Mountain and NE of Terrace mountain, approximately 6 km N of Skeena River and 60 km N of head of Kitimat Arm.

BOUNDARIES

Mountainous terrain to N and E, Terrace District Municipality boundary to S, and Deep Creek and Kalum Lake Road to northern and southern portions of W boundary, respectively.

TERRAIN CONDITIONS

Relatively level plateau; general elevation approximately 120-185 m, mild slope to SW toward Kitsumkalum River from mountainous terrain at northern and eastern boundaries. Approximately 500 Ha through western portion of site, primarily in SW corner, situated on Kitsumkalum River floodplain. Timber cover logged from portions of site.

ACCESS AND TRANSPORTATION

No direct tidewater access. Existing Kalum Lake Road parallels western site boundary, unimproved roads branch through central and eastern portions. Kalum Lake Road proposed to be upgraded, linked to Highway 16 connecting Prince Rupert and Prince George via Terrace, and integrated with Highway 25 connecting Kitimat and Terrace along E side Kitimat-Terrace Valley to improve access to communities to N including Stewart, Cassiar and Watson Lake at northern terminus. No existing on-site rail access; rail route serving Prince Rupert-Prince George situated approximately 4 km S of site, connects with Kitimat-Terrace route serving Kitimat-Terrace Corridor industrial sites to S. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing or proposed on-site utilities. Existing hydroelectric lines approximately 2 km to S and 3 km to W of site; existing gas route approximately 4 km to S. Fresh water could be provided by Kitsumkalum River to W or Skeena River to S.

POTENTIAL LAND USE CONFLICTS

Not presently or proposed to be utilized as a park, recreational or residential area. Low archaeological potential over entire site, no I.R.'s within site boundaries. Situated directly NW across Kitsumkalum River from 1,300 ha Kitsumkalum Mountain Recreation Area; 2,500 ha watershed reserve adjacent to E. ALR covers over 50% of site, remaining area designated by Kitimat-Stikine Regional District for potential residential development. Air dispersion generally northward, occasionally southward in winter; potential conflict with operation of Terrace-Kitimat Airport approximately 8 km to S.[1] No significant fisheries or other potential conflicts identified.

POTENTIAL USERS

No indication of development suitability specified for particular industries.

Source: Acres Consulting Services Limited. Kitimat Steel Mill Preliminary Site Selection Study, British Columbia Development Corporation, 1982.

COPPER CITY FLATS SITE

PARCEL DESCRIPTION

325 ha site, irregularly rectangular in shape. Dimensions approximately 0.7 km N-S by 4.4 km E-W.

LOCATION

3 km NE of Terrace City Centre. Occupies riverfront area on N side of Skeena River immediately E of Terrace Mountain and directly N of District of Thornhill, approximately 59 km N of head of Kitimat Arm.

BOUNDARIES

Steeply mountainous terrain to W and N, and Skeena River to S and E.

TERRAIN CONDITIONS

Relatively level riverfront site; general elevation approximately 60-90 m, mild slope to SE toward Skeena River boundary from mountainous terrain at northern and western boundaries. Entirely situated on Skeena River 200 year floodplain. Southern portion of site includes approximately 40 ha Shremp Island, a 1,500 m long sandbar separated from bulk of site area to N by narrow channel during flood periods only.13 Timber cover primarily deciduous, largely intact over majority of site.13

ACCESS AND TRANSPORTATION

No direct tidewater access. No existing road access; proposed West Skeena Forest Access Road alignment crosses central portion of site E-W, planned route to skirt S base of Terrace Mountain, connect with Terrace City Centre. Existing Prince Rupert-Prince George rail line parallels proposed road alignment through central portion of site. Site not planned to be integrated into proposed Kitimat Valley IUTC (industrial transportation, utilities and materials handling corridor).

UTILITIES

No existing or proposed on-site utilities. Existing hydroelectric lines approximately 3 km to SW on N side of Skeena River and 1 km to S across Skeena River. Existing gas routes approximately 2 km to SW on N side of Skeena River and 0.5 km to S across Skeena River. Fresh water could be provided by Skeena River.

POTENTIAL LAND USE CONFLICTS

Not presently or proposed to be utilized as a park, recreational or residential area. Moderate archaeological potential over majority of site, moderately high potential through extreme western portion; no I.R.'s within site boundaries. ALR encompasses entire site; approximately 70% Class 3, 30% Class 5 soils.8 Situated approximately 2 km to S of 2,500 ha watershed reserve. Air dispersion generally northward, occasionally southward in winter; potential conflict with operation of Terrace-Kitimat Airport approximately 7 km to S.1 Potential fisheries conflict associated with riverfront industrial location, depending on nature and siting of development. No other potential conflicts identified.

POTENTIAL USERS

Considered by CNR as location for railway marshalling yards.

Source: Kerby, N. Terrace Community Plan, 1980-1990: Analysis and Dimension, District of Terrace, 1979.

APPENDIX A: FOOTNOTES

		Page No.
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9.	Mayhew, Brian, Planning Director, District of Kitimat. Pers. Com., September, 1982.	A-4, A-5 A-9, A-10 A-12, A-13 A-14
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APPENDIX B - BREAKDOWN CONCEPTUAL COST ESTIMATES FOR INFRASTRUCTURAL COSTS TO POTENTIAL DEVELOPMENT SITES

APPENDIX B

BREAKDOWN CONCEPTUAL COST ESTIMATES FOR INFRASTRUCTURAL COSTS TO POTENTIAL DEVELOPMENT SITES

INFRASTRUCTURAL COSTS FOR DOUGLAS CHANNEL SITES

Miskatla Inlet:

ROAD	28 km	$17,000,000	
	2 bridges - major crossing	1,100,000	
	4 bridges - minor crossing	600,000	$18,700,000
RAIL	33 km	$25,000,000	
	2 bridges - major crossing	1,100,000	
	4 bridges - minor crossing	600,000	26,700,000
GAS	33 km		4,000,000
ELECTRICITY	30 km		3,100,000
		Total:	$52,500,000

Emsley Cove:

ROAD	12 km	$ 7,000,000	
	1 bridge - major crossing	500,000	
	2 bridges - minor crossing	300,000	$ 7,800,000
RAIL	17 km	$13,100,000	
	1 bridge - major crossing	500,000	
	2 bridges - minor crossing	300,000	13,900,000
GAS	17 km		2,000,000
ELECTRICITY	14 km		1,500,000
		Total:	$25,200,000

Bish Creek:

ROAD	8 km	$ 5,000,000	
	1 bridge - minor crossing	200,000	$ 5,200,000
RAIL	13 km	$10,000,000	
	1 bridge - minor crossing	200,000	10,200,000
GAS	13 km		1,500,000
ELECTRICITY	10 km		1,000,000
		Total:	$17,900,000

Kitamaat:

ROAD	7 km Upgrade	$ 1,000,000	
	2 km - New	1,200,000	$ 2,200,000
RAIL	14 km	$10,500,000	
	1 bridge - major crossing	2,000,000	12,500,000
GAS	15 km		2,100,000
ELECTRICITY	Connect to site		20,000
		Total:	$16,820,000

Wathlsto Creek:

ROAD	7 km Upgrade	$ 1,000,000	
	9 km New	5,400,000	$ 6,400,000
RAIL	21 km	$15,800,000	
	1 bridge - major crossing	2,000,000	17,800,000
GAS	22 km		3,100,000
ELECTRICITY	3 km		400,000
		Total:	$27,700,000

Clio Bay:

ROAD	7 km Upgrade	$ 1,000,000	
	12 km - New	7,500,000	
	2 bridges - minor crossing	300,000	$ 8,800,000
RAIL	24 km	$18,000,000	
	1 bridge - major crossing	2,000,000	20,000,000
GAS	25 km		3,200,000
ELECTRICITY	4 km		500,000
		Total:	$32,500,000

Dala River:

ROAD	32 km	$19,000,000	
	5 bridges - minor crossing	800,000	$19,800,000
RAIL	37 km	$27,800,000	
	1 bridge - major crossing	2,000,000	
	5 bridges - minor crossing	800,000	30,600,000
GAS	38 km		4,600,000
ELECTRICITY	connect		20,000
		Total:	$55,020,000

SUB-TOTAL - Infrastructure Costs to Douglas Channel Sites	$227,640,000

INFRASTRUCTURAL COSTS FOR KITIMAT HARBOUR SITES

Harbour West:

ROAD	connect		$ 100,000
RAIL	5 km		3,900,000
GAS	5 km		600,000
ELECTRICITY	4 km		500,000
		Total:	$ 5,100,000

Eurocan Wharf:

ROAD			serviced
RAIL	4 km		$ 3,100,000
GAS	2 km		300,000
ELECTRICITY			serviced
		Total:	$ 3,400,000

Harbour East:

ROAD	connect	$ 200,000	
	1 bridge - major crossing	500,000	$ 700,000
RAIL	5 km	$3,900,000	
	1 bridge - major crossing	500,000	4,400,000
GAS	3 km		400,000
ELECTRICITY	connect		20,000
		Total:	$ 5,520,000

Alcan Plant & Reserve:	Fully serviced
SUB-TOTAL - Infrastructure Service Costs to Kitimat Harbour Sites:	$14,020,000

INFRASTRUCTURAL COSTS FOR SOUTH CORRIDOR SITES

Harbour Back-up:

ROAD	1 km		$ 700,000
RAIL	0.5 km		500,000
GAS	3 km		400,000
ELECTRICITY	connect		20,000
		Total:	$ 1,620,000

Sandhill:

ROAD	connect		$ 100,000
RAIL	0.5 km		600,000
GAS	connect		30,000
ELECTRICITY	connect		20,000
		Total:	$ 750,000

Service Centre:

ROAD	connect		$ 100,000
RAIL			serviced
GAS	connect		30,000
ELECTRICITY	connect		20,000
		Total:	$ 150,000

Northern:

ROAD	connect		$ 100,000
RAIL	connect		200,000
GAS	connect		30,000
ELECTRICITY	connect		20,000
		Total:	$ 350,000

Wedeene:

ROAD	connect	$ 100,000
RAIL	connect	200,000
GAS	1 km	200,000
ELECTRICITY	1 km	100,000
	Total:	$ 600,000

SUB-TOTAL - Infrastructure Service Costs for South Corridor Sites:	$ 3,470,000

INFRASTRUCTURAL COSTS FOR NORTH CORRIDOR SITES

Dubose:

ROAD	1 km	$ 700,000	
	1 bridge - minor crossing	200,000	$ 900,000
RAIL	connect		200,000
GAS	1 km		200,000
ELECTRICITY	1 km		100,000
		Total:	$ 1,400,000

Thunderbird:

ROAD	connect	$ 100,000
RAIL	connect	200,000
GAS	connect	30,000
ELECTRICITY	connect	20,000
	Total:	$ 350,000

Terrace North:

ROAD	connect		$ 100,000
RAIL	7 km	$ 6,000,000	
	2 bridges - minor crossing	300,000	6,300,000
GAS	10 km		1,500,000
ELECTRICITY	4 km		400,000
		Total:	$ 8,300,000

Copper City Flats:

ROAD	2 km		$ 1,300,000
RAIL	connect		200,000
GAS	6 km		1,100,000
ELECTRICITY	5 km		500,000
		Total:	$ 3,100,000

Terrace Airport:

ROAD	connect		$ 100,000
RAIL	connect		200,000
GAS	connect		30,000
ELECTRICITY	connect		20,000
		Total:	$ 350,000

SUB-TOTAL - Infrastructural Service Costs for North Corridor Sites: $13,500,000

TOTAL CONCEPTUAL COST FOR INFRASTRUCTURAL SERVICES: $258,630,000

APPENDIX C - THE QUESTIONNAIRE

APPENDIX C
KITIMAT-TERRACE CORRIDOR INDUSTRIAL LAND USE STUDY
PRIVATE SECTOR QUESTIONNAIRE

SECTION ONE

1.0 Organization:
Address:

Type of Industry:

2.0 Nature of Industrial Development:

2.1 New Plant:

2.2 Expansion of Existing operations:

2.3 Anticipated scale (size) of development:

2.4 Site Preference:

2.5 Description of plant (industry):

3.0 Go to Tables - Infrastructure and Economic Conditions.

SECTION TWO

4.0 Project Development

4.1 Overall, which set of criteria is more essential to project go-ahead only (Please circle [a] or [b])

[a] Infrastructure requirements (transportation, resources, services),
or
[b] Economic factors?

What is the relative importance of [a] to [b]? Please indicate on the line below.

1	2	3	4	5
[a] much more important than [b]		[a] and [b] of same importance		[b] much more important than [a]

4.2 Which five individual factors (outlined as requirements and constraints in Tables 1 and 2) are most essential to project go-ahead. Please rank these factors in order of importance. Indicate the critically important factors by placing (C) in brackets after the factor.

1. ______
2. ______
3. ______
4. ______
5. ______

SECTION THREE

5.0 Timing of Development:

5.1 Do you have a preferred start-up year?
When? (State, for example, as January 1, 1986 to December 31, 1991)

5.2 Do you have a range of possible start-up years?
(State the range for example, January 1, 1986 to December 31, 1991)

5.3 How important is it to start on or by the preferred year?

1	2	3	4	5
Very Important		Important		Not Important

5.4 Which five individual factors (outlined as requirements and constraints in Tables 1 and 2) are most essential to timing of development. Please rank these factors in order of importance. Indicate critically important factors by placing (C) in brackets adjacent to the factor.

1. ______
2. ______
3. ______
4. ______
5. ______

5.5 Which has a greater impact on timing? (Please circle [a] or [b])

[a] Need to start development as soon as possible
or
[b] Net effect of the five selected factors?

What is the relative importance of [a] to [b]? Please indicate on the line below.

1	2	3	4	5
[a] much more important than [b]		[a] and [b] same importance	[b] much more important than [a]	

5.6 Overall, which set of criteria is more essential to project timing only (Please circle [a] or [b])

[a] Infrastructural requirements,
or
[b] Economic factors?

What is the relative importance of [a] to [b]. Please indicate on the line below.

1	2	3	4	5
[a] much more important than [b]		[a] and [b] same importance		[b] much more important than [a]

SECTION FOUR

6.0 Possible associated Developments (upstream or downstream industries)

7.0 Do you know of other industries possibly interested in locating in the Kitimat-Terrace Corridor?

PUBLIC SECTOR QUESTIONNAIRE

Name of Respondent:
Agency Represented:

1. Based on your knowledge of the area and contact with private and public agencies, what industries have indicated an interest to locate in the Kitimat-Terrace Corridor? Which industrial sectors are most likely to develop in the Corridor?

2. For each of the identified industries or industrial sectors, assess the economic, (and, if appropriate, infrastructural) factors required to facilitate industrial development (go to Tables 1 and 2).

3. What is the view of your ministry/agency regarding development of the Kitimat-Terrace Corridor?

TABLE C-1 REQUIREMENTS AND CONSTRAINTS AFFECTING INDUSTRIAL DEVELOPMENT:

REQUIREMENT/CONSTRAINT		REQUIREMENTS	CONSTRAINTS	POSSIBLE REPLACEMENT BY OTHER SERVICES/FACILITIES
Transportation	● Road ● Rail ● Pipelines ● Transmission Lines ● Port Facilities ● Other			
Resources	● Manpower ● Technology ● Raw Materials ● Energy ● Capital ● Other			
Services	● Sanitary Sewer ● Waterworks ● Drainage Works ● Local Access ● Fire/Police Protection ● Communications			

TABLE C-2 ECONOMIC CONDITIONS REQUIRED FOR INDUSTRIAL DEVELOPMENT

Economic Parameters	Desired Quantity or Level (Ave. annual)	Probability of Attaining the Desired Quantity or Level					Minimum Acceptable Quantity or Level for Project Go-ahead (Ave. Ann)	Probability of Attaining Minimum Quantity or Level				
		None				Certain		None				Certain
● Market Size (min.) - unit sales		1	2	3	4	5		1	2	3	4	5
● Market Price (min.) - unit price		1	2	3	4	5		1	2	3	4	5
● Costs (maximum percent of total expenses)												
- Labour		1	2	3	4	5		1	2	3	4	5
- Materials		1	2	3	4	5		1	2	3	4	5
- Energy		1	2	3	4	5		1	2	3	4	5
- Operating		1	2	3	4	5		1	2	3	4	5
● Inflation (max.)												
- Wages		1	2	3	4	5		1	2	3	4	5
- Material		1	2	3	4	5		1	2	3	4	5
- Energy		1	2	3	4	5		1	2	3	4	5
● Cost of Capital (max.)												
- nominal interest rates		1	2	3	4	5		1	2	3	4	5
● Canadian/US dollar exchange rate (max)		1	2	3	4	5		1	2	3	4	5
● Other:												
- Market stability*		1	2	3	4	5		1	2	3	4	5
		1	2	3	4	5		1	2	3	4	5
		1	2	3	4	5		1	2	3	4	5

* State your own criteria or comment

Note: All monetary values should be stated in constant Canadian 1982 dollars unless otherwise indicated.

APPENDIX D - LISTS OF CONTACTS

APPENDIX D: LISTS OF CONTACTS

D-1 Contacts Utilized Primarily for Construction of Probability Assessments

Name	Organization	Project
R. Schwartz Planning & Development Engineer	B.C. Timber Ltd. 1176 West Georgia Street Vancouver, B.C. V6A 2A8	Mill upgrading
B. Wasson Vice President	Eurocan Pulp and Paper Co. Ltd. 1176 West Georgia Street Vancouver, B.C. V6E 2K1	New sawmill
J. Hall 664-5676	Pacific Northern Gas Ltd. 1477 West Pender Street Vancouver, B.C. V6E 4B2	Coal slurry pipeline
G. Artz	Ministry of Industry and Small Business Development 800 Robson Street Vancouver, B.C. V6Z 2C6	Steel mill
L. Holroyd Director of Corporate Affairs Bob Kraft - Senior Business Analyst	Aluminium Company of Canada Ltd. 1285 West Pender Street Vancouver, B.C. V6A 1W7	Aluminum smelter
L. Scofield* 387-5231	Ministry of Energy, Mines & Petroleum Resources	Oil pipeline terminal
B. Parrott* 387-3707	Ministry of Industry and Small Business Development	Lead/zinc smelter Copper smelter
R. Dunbar* Project Manager 403-232-8000	Petro-Canada Exploration Inc. P.O. Box 2844 Calgary, T2P 3E3	LNG plant

APPENDIX D: LISTS OF CONTACTS (cont'd)

D-1 Contacts Utilized Primarily for Construction of Probability Assessments (cont'd)

Name	Organization	Project
B. Soutiere* 403-259-6347	Canada Liquid Air Inc. 3004 - 54th Avenue SW Calgary, T2C 0A7	Air separation plant
Mr. Rutherford* 403-423-4075	Chieftain Development Co. Ltd. Toronto Dominion Tower 148 Edmonton Centre Edmonton, T5J 2Z1	Coal slurry (methanol) pipeline
Mr. J. Lamb* 416-276-9333 (Mr. Nigel Cole - Project Manager)	Celanese Canada Inc. 900 - 2 Robert Spec Parkway Mississauga, Ontario L4Z 1H8	Methanol pipeline and transshipment
W. Sidjak*	Ocelot Industries Ltd. 435 - 550 6th Avenue SW Calgary, T2P 0S2	Methanol plant expansion Ammonia & urea plants
Dr. Burrard* (403-290-6000)	NOVA - An Alberta Corporation 801 - 7th Avenue, S.W. Calgary, Alberta T2P 1A2	Petro-chemical shipping

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Note: * - Telephone contact only.

APPENDIX D: LISTS OF CONTACTS (cont'd)

D-2 Other Vancouver Contacts

Mr. Lessing Director of Timber, Land and Properties (683-6711)	MacMillan Bloedel Ltd. 1075 West Georgia Street Vancouver, B.C. V6E 3C9
A. Furniss (687-8027)	Association of B.C. Professional Foresters 406 - 837 West Hastings St. Vancouver, B.C. V6C 1B6
J.R. O'Rourke Regional Manager (665-4206)	Canadian National Railways Suite 200 - 777 Hornby St. Vancouver, B.C. V6Z 1S4
J.J. Munro President (683-1117)	International Woodworkers of America - Regional Council No.1 500 - 1285 West Pender Street Vancouver, B.C. V6E 4B2
M. Gillis Planner (294-5211)	Provincial Agricultural Land Commission 4940 Canada Way Burnaby, B.C., V5G 4K6
J. North, Rate Analyst (669-2922)	B.C. Hydro and Power Authority Rates & Charges Division 970 Burrard Street Vancouver, B.C. V6Z 1Y3
K. Ball Director (689-8411)	B.C. Development Corporation Industrial Land Division 272 Granville Square Vancouver, B.C. V6C 1S4
G. Littlejohn (668-4242)	Crown Zellerbach Canada Ltd. 7th Floor - 815 West Hastings St. Vancouver, B.C. V6E 2K1
Mr. Eastman	Placer Development Ltd. 1600 - 1055 Dunsmuir Street Vancouver, B.C. V6C 1A8

APPENDIX D: LISTS OF CONTACTS (cont'd)

D-3 Other Contacts Made in Kitimat and Terrace

KITIMAT: Interviews conducted in Kitimat, B.C.

A. Hewitson A. Gulke	Aluminum Company of Canada Ltd.
S. Fritter P. Connor	Eurocan Pulp and Paper Co.
C.W. Sverre	MacMillan Bloedel Limited
M. Lubke	Canadian Paper Workers Union
S. McPherson G. Mauro	Association of Professional Foresters
F. Mauro	Canadian Union of Public Employees
Kitimat Council members:	- Hans Brown - Max Patzalt - Joanne Monaghan
Advisory Development Commission:	- Alvin Zaharko - Lloyd Scott - Jim Muir
R. Perrier	Canadian Association of Smelter and Allied Workers (CASAW)
E. Cotton	Ocelot Industries Ltd.
R. Forward	Chamber of Commerce, Kitimat

TERRACE: Interviews conducted at Regional District office, Terrace, B.C.

L. Kozier	Kitsumkalum Farmers Institute
S. Hamilton	Skeena Protection Coalition
R.M. Cooper	District of Terrace - Council Representative
E.O. Field	B.C. Hydro & Power Authority Ltd.

APPENDIX D: LISTS OF CONTACTS (cont'd)

D-3 Kitimat and Terrace Contacts (cont'd)

TERRACE: (cont'd)

P. Ostergaard	Ministry of Municipal Affairs
B. Sieffert	Ministry of Forests (Smithers)
J. Culp E. Hamilton	Regional District of Kitimat-Stikine
W. Epp	Pacific Northern Gas Ltd.
D. McColl	Northwest Loggers Association
Mr. Lawrence	B.C. Timber Ltd.
C. Pool	Chamber of Commerce, Terrace
T. Cook	Terrace-Kitimat Airport Transport Canada
F.J. Halberg	Canadian National Railway
J. Pousette	Regional Economic Development Commissioner
B. Hutchinson	International Woodworkers Association
Francis Birdsell	Terrace Womens Resource Centre

APPENDIX D: LISTS OF CONTACTS (cont'd)

D-4 Government Contacts in Victoria

M. Oswell H. Sasaki	Ministry of Agriculture and Food 808 Douglas Street Victoria, B.C. V8W 2Z7
J. Turner	Department of Regional Economic Expansion - Industrial Development 1176 Douglas Street Victoria, B.C. V8W 2E1
G. Roberts	Ministry of Lands, Parks and Housing 1019 Wharf Street Victoria, B.C. V8W 2Z3
G. A. Clarke R. Cowley P. Lofthouse D. R. Parkes D. Ostrowski K. Rayner	Ministry of Transportation and Highways - Transport Policy and Analyses Branch 2631 Douglas Street Victoria, B.C. V8T 4X7
D. Walton R. Gubbe J. Mason W. Malkinson B. Parrott A. Fraser	Ministry of Industry and Small Business Development 1405 Douglas Street Victoria, B.C. V8W 3C1
T. Knight C. Highstead	Ministry of Forests 1405 Douglas Street Victoria, B.C. V8W 3E7
J. Clancy	Ministry of Energy, Mines and Petroleum Resources 525 Superior Street Victoria, B.C. V8V 1X4
T. Boydell	Ministry of Environment 777 Broughton Street Victoria, B.C. V8W 1E3
D. White	Ministry of Tourism 1117 Wharf Street Victoria, B.C. V8W 2Z2

APPENDIX E - GENERAL METHODOLOGY FOR PROBABILITY MODEL

APPENDIX E

GENERAL METHODOLOGY FOR PROBABILITY MODEL

The mathematical structure of the probability model is explained below. A glossary of pertinent mathematical terms has been included at the end of this appendix to facilitate comprehension of descriptive terminology.

- Mathematical Structure of the Model

The overall model is predicated upon Bayes' theorem of conditional probabilities which links joint and conditional probabilities. Mathematically, this theorem is indicated as:

$$P\,(B/A) = \frac{P\,(B \cap A)}{P\,(A)}$$

where: A and B represent outcomes or events;

$P(B)$	represents the probability of event B occurring;
$P(B \cap A)$	represents the joint probability of B and A both occurring;
$P(B/A)$	represents the probability of B occurring, given that A has already occurred.

Since our key objective has been to examine individual project scenarios from the perspective of the joint probabilities of project go-ahead, and in a specific year or range of years, and to thereby rank and assign likelihoods to different overall timing patterns of project combinations, each of the three initial phases of the probability model corresponds to one component of Bayes' theorem respectively as follows:

Phase 1 is equivalent to calculating P(A)
Phase 2 is equivalent to calculation P (B/A)
Phase 3 solves for P ($B \cap A$) by combining the results of Phases 1 and 2. [i.e. P ($B \cap A$) = P(A) x P (B/A)]

where: Event A is defined as project go-ahead.
Event B is defined as project start-up in a given year.

- Approach to Probability Assessment

Five-year marginal probabilities of project go-ahead for each project were calculated in discrete 5-year time blocks between 1983 and 2,003, and ranked both cardinally and ordinally, under conditions of low, medium, and high economic growth.

In addition, the overall probabilities of project go-ahead between 1983 and 2,003 were also ranked cardinally and ordinally for each project under conditions of low, medium, and high economic growth.

In all instances, statistical independence was assumed for each project (i.e. the development of one project was not necessarily contingent upon the development of any others).

In all instances of cardinal and ordinal ranking of probabilities, the quantitative probability listed represented either a single joint probability, or a sum of joint probabilities (in the cases of the ranking, in 5-year blocks).

The intent of the probability exercise was not to determine definitive probability values under all applicable circumstances, it was, rather, to utilize the cardinal values obtained as a mechanism to develop ordinal rankings, as well as to illustrate the relative magnitudes of the chances of project go-ahead under different economic scenarios. In developing the various joint probabilities for each of the projects, those critical factors or constraints were identified by each project representative which were so essential to project go-ahead, that if one factor or constraint were not met, the project would be cancelled.

In assigning probabilities for each factor or constraint being met, the most stringent effort was made to avoid statistical bias. The following guidelines were therefore adopted:

- Quantitative probabilities directly provided by project representatives were utilized in the computations in the exact amounts provided;

- For factors or constraints commonly identified for several projects, but for which no probabilities were provided, identical probabilities were assigned in-house under the alternative conditions of economic growth. Thus, for example, if several respondents identified environmental concerns as a critical factor and subsequently provided no probabilities for this factor, in-house probabilities of 0.8, 0.9, and 1.0 were assigned under conditions of high, medium, and low economic growth respectively. The rationale for this approach was that if insufficient data existed to calculate a set of probabilities, at least the ordinal rankings would not be affected, since all projects would be equally affected by such probability assignments.

Thus if, for example, it were decided to alter the probabilities for the environmental concerns constraint to 0.6, 0.8, and 0.9 under conditions of high, medium, and low economic growth, the cardinal rankings of the projects by probability would be affected, but the relative ordinal rankings would not change at all.

The in-house probabilities assigned in this "blanket probability" approach for various constraints were based on logical assumptions. In assigning blanket probabilities for environmental concerns, for example, it was assumed that a low-growth economy would be less sensitive to environmental considerations than a high-growth economy.

- When no other recourse remained for assignment of probabilities to factors or constraints (i.e. when the 2 aforementioned guidelines could not be applied), in-house probabilities were assigned on the basis of discussion, research, and conservatism.

For each project, if one or more constraint probabilities were changed for the particular project alone, the cardinal rankings under all different economic scenarios would certainly change, and the ordinal rankings might or might not be affected, depending upon the magnitude of the probability changes.

- **Phase 1 - Determination of Go-Ahead Probabilities per Project Scenario**

Methodology for Phase 1

The 5 major constraints or requirements for project go-ahead were identified by the interviewees in their individual questionnaire responses.

The probability of successfully meeting a requirement or constraint was then assessed for each of those stated (maximum of five), and for conditions of low, medium and high economic growth.

Each requirement probability was then multiplied by the next in chain-like fashion to yield the joint probability of project go-ahead.

Mathematically, this procedure is be represented as:
$P_j = P1 \times P2 \times P3 \times P4 \times P5$, where;

P_j = the joint probability of all 5 requirements being met.
P_1 = the probability of requirement 1 being met.
P_2 = the probability of requirement 2 being met.
P_3 = the probability of requirement 3 being met.
P_4 = the probability of requirement 4 being met.
P_5 = the probability of requirement 5 being met.

Assumptions for Phase 1

- All probabilities are marginal and may be comprised of one or more sub-events.

- All final outcomes or events are statistically independent. Had this assumption not been made, evaluation of conditional probabilities to reflect hypothesized linkages of events in Phase 1 could have involved potentially spurious assumptions of forecasted economic conditions and interrelationships.

  For example, it may be argued that cost of capital (a possible requirement) is linked to the rate of inflation (another requirement). However, as currently illustrated by economic conditions in the United States, inflation is relatively low while cost of capital is extremely high. On other historical occasions in North America, (e.g. in 1974-75, following an Arab Oil embargo), the cost of capital ran below inflation (as measured by the CPI).

  Finally, future linkages to incorporate statistical dependence among events in Phase 1 may be included later in the model through revision with posterior probabilities.

- Since the questionnaire requested that the respondent list those 5 (or less) factors most critical to project go-ahead, it was assumed that failure to minimally meet even one requirement or constraint would cause the project to fail, since all requirements/constraints are statistically independent of each other.

Assignment of Probabilities for Each Project Scenario: Project Go-Ahead Only

To assist in assigning the probability of project go-ahead for each scenario, each respondent was asked to list those requirements or constraints most critical to project go-ahead. Up to five could be chosen. Each of the listed requirements/constraints was assumed to be statistically independent from the others. Thus, by multiplying the probabilities associated with each requirement/constraint, the joint probability of project go-ahead could be determined.

The probabilities were assigned to the individual requirements/constraints for the conditions of:

- Low economic growth: Provincial GDP = negative to +2%
- Medium economic growth: Provincial GDP = +3% to +5%
- High economic growth: Provincial GDP = 6%+

To avoid statistical bias, the exact probabilities supplied by the respondents were used whenever provided.

To avoid statistical bias for requirements/constraints for which no probabilities were provided, identical criteria were employed in assigning probabilities as often as possible for all scenarios, to preclude affecting the relative rankings. For example, environmental considerations was listed as a constraint, and if no probabilities were assigned by the respondent, for all such projects the probability of meeting the constraint was set = 1 for low economic growth (during a period of low growth, environmental concerns are far less important than economic considerations, and gain in importance as the economy increases), .9 for medium economic growth and .8 for high economic growth.

Therefore ranking projects by joint probability under different economic scenarios, although not indicative in absolute terms, rankings are indicative in relative terms.

- **Phase 2 - Determination of Start-Up Probabilities per Project Scenario**

In an analogous fashion to Phase 1, the five (or less) requirements/constraints critical to project timing rather than go-ahead were derived, and also weighted from the questionnaire responses.

The mathematical rationale of the probability model required assuming that project go-ahead would occur in all scenarios for this phase. The objective of this phase was therefore to develop for each project scenario, a probability distribution of start-up timing, indicating for each year of the 21-year time period under consideration, the probability of project start-up occurring in that year.

Since 5 (or less) different constraint/requirements were identified as critical to timing, a different start-up timing probability distribution could have been developed for each one. The final objective, however, necessitated developing one overall timing distribution, which would blend the disparate distributions.

Methodology for Phase 2

For each timing constraint, a probability distribution of start-up timing could be developed over 21 years, with the probability of project start-up indicated for each year, and the sum of all probabilities equal to 1.0.

Assuming that for each individual year from 1983 to 2003, probabilities exist for each of the timing constraints, and that all those constraints have been weighted, the overall "probability factors" can be defined for each year as follows:

$$\text{probability factor} = \frac{\sum Wi \times Pi}{\sum Wi}$$

where: Wi = Weight of constraint
Pi = Probability of successfully meeting the constraint

Once overall probability factors have been determined for each individual year, they can be pro-rated as decimal fractions to the sum of all the overall factors, providing a blended timing probability distribution indicating the probability by year of project start-up, given the assumption of project go-ahead.

Although the computer model was initially developed to include a program to specifically create a blended timing distribution for each scenario according to aforementioned mathematical criteria, pertinent information regarding start-up timing was not provided in all instances, and resultant anomalies in data were created which were left would necessitate too many potentially false assumptions for a finely-tuned computer model.
Blended timing distributions were thus developed heuristically for each project scenario, based on the principles of mathematical timing and probability weighting as described above. Assumptions that had to be made for these heuristic distributions were developed collectively by pertinent members of Acres staff, and reflected their collective judgement regarding the nature of B.C. industry.

A sample run of this blended timing program, incorporating hypothetical data, has been included in the Appendices.

Assumption for Phase 2

Weighting factors of constraints/requirements remain intially constant for each project over 21 years. They may be updated interactively at any later stage in time.

Assignment of Probabilities for Each Project Scenario: Project Timing Only

Originally, a blended timing distribution was intended for each scenario, generated by a computer program. Due to lack of general timing, information supplied by clients, timing probabilities were assigned according to the following criteria:

- If a range of project start-up years was provided by the respondent, a timing probability curve was drawn between those years. Otherwise, the timing probability curve was drawn between 1983 and 2003;
- For low economic growth, the curve was skewed to the left;
- For high economic growth, the curve was skewed to the right;
- For medium economic growth, a bell curve was used;
- The degree of Kurtosis for each curve reflected the respondents' certainty of timing probability within a range of years. Therefore the more certain the response for a given range of years, the more leptokurtic the curve for those years.

- Timing probabilities were calculated directly by reading values from the curves. The weightings for each timing requirement/constraint were not utilized, but maintained for future possible use.

- Phase 3 - Determination of Joint Probabilities of Go-Ahead and Start-Up

Phase 3 involved straightforward application of Bayes' theorem, as indicated in the general methodology, to the results of Phases 1 and 2.

Methodology for Phase 3

For each project scenario, the overall probability of project go-ahead calculated in Phase 1 was multiplied by each annual probability figure in the blended timing probability distribution in Phase 2, to provide, on an annual basis, the joint probabilities of project go ahead and start-up for that particular year. Results of these calculations are generated in Phase 3.

- Phase 4 - Ranking of Projects by Go-Ahead and Start-Up Probabilities

This phase consisted of ranking and assessing scenarios, based on the results of the first 3 phases, in the following sequence:

- Each project scenario has been ranked individually for the probability of go ahead, under conditions of high, low and medium growth. Table 4-3 lists these rankings by magnitude of joint probability.

- Under conditions of high, medium and low economic growth, the marginal probabilities of project go-ahead per scenario were calculated in blocks of 5 years, with the exception of the last block, 1998-2003, which is 6 years long. In an analagous fashion to (a), project scenarios were then ranked by the magnitude of probability of project go-ahead for each specific 5-year block. Results of these rankings and their attendant marginal probabilities are provided in Tables 4-8, 4-9 and 4-10 of Section 4.0.

- Final project timing patterns were prepared for high, medium and low growth, and ranked by probability, calculated by combining the results in Tables 4-3 to 4-6.

The 21-year project timing patterns which ranked highest and lowest, for each economic scenario, are indicated in Tables 4-4 to 4-6 with their attendant marginal probabilities. In addition, two intermediate project timing patterns have been included for each economic scenario, with the second best timing combination, deemed more likely than third best timing combination.

GLOSSARY OF TERMS

Bayes' Theorem:

A mathematical formula used to link events under statistical dependence by calculating conditional probability

Conditional Probability:

The probability of an event occuring, given that another event has already occured

Event:

One or more of the possible outcomes of an experiment, or of any situation which has several potential outcomes. An event may be composed of one or more sub-events

Joint Probability:

The probability of statistically independent events being concurrent

Marginal Probability:

The unconditional probability of an event. It may represent the sum of several sub-events, each constituting a unique joint probability

Probability:

The likelihood, usually expressed in decimal form or as a percentage, of an event occuring

GLOSSARY OF TERMS
(continued)

POSTERIOR PROBABILITY:

A probability that has been revised as a result of receiving new or additional data.

STATISTICAL DEPENDENCE:

The condition wherein the outcome of a certain event is dependent upon, or affected by, the outcome of another event.

STATISTICAL INDEPENDENCE:

The condition wherein the concurrence of two or more events is such that none of the component events in the concurrence is conditionally related to the outcomes of any of the other component events.

TABLE E-1

FORECASTED ESCALATION RATE INDICES

Year	MTC[1]	WAG[2]	CAP[3]	CPI[4]	ELEC[5]	BRC[6]
1983	9.8	10.1	9.8	10.7	15.7	10.4
1984	9.8	10.1	9.8	10.7	15.7	10.4
1985	9.8	10.1	9.8	10.7	15.7	10.4
1986	7.7	7.4	7.7	8.8	8.8	8.0
1987	7.7	7.4	7.7	8.8	8.8	8.0
1988	7.7	7.4	7.7	8.8	8.8	8.0
1989	7.7	7.4	7.7	8.8	8.8	8.0
1990	7.7	7.4	7.7	8.8	8.8	8.0
1991	5.7	6.7	5.7	6.7	6.7	6.7
1992 to 1995	5.7	6.7	5.7	6.7	6.7	6.7
1996 to 2008	5.9	6.6	5.9	6.6	6.6	6.6

1 Maintenance
2 Wages
3 Capital Costs
4 Consumer Price Index
5 Electricity
6 Blended Replacement Cost

TABLE E-1 (cont'd)

Cost Indices

1 Maintenance (MTC)

This DRI (Data Resources Incorporated) forecast for the annual rate of change in the Industry Selling Price Index (ISPI) represents average maintenance cost escalation rates. Note that the ISPI is expected to grow at a slower rate than the Consumer Price Index (CPI).

2 Wages - Unit Labor Costs (WAG)

In this DRI forecast unit labor costs rather than wage escalation rates were utilized in order to reflect changes in productivity. The DRI Unit Labor Cost forecasts for 1983 to 1995 were selected, with the remaining years escalating at the same rate as the Consumer Price Index.

3 Capital (CAP)

The price of capital goods was also assumed to escalate at the rate of the Industry Selling Price Index.

4 Consumer Price Index (CPI)

As the ECC (Economic Council of Canada) forecasts for the CPI were slightly higher than the DRI forecasts over the years 1983 to 1990, an average of the two was calculated. Growth rates over five-year intervals were utilized, and for the years 1990 to 2000 the DRI forecast alone is shown.

TABLE E-1 (cont'd)

5 Electricity (ELEC)

Electricity price forecasts were obtained from B.C. Hydro. These forecasts reflect a catch-up phase for the years 1983 to 1985 where electricity prices are 5 percent above the CPI. For the remaining years electricity prices are projected to grow at the same rate as the CPI.

6 Blended Replacement Cost Index

Since the overall escalation of a project's replacement costs alone necessitate the application of the five previous index sets, an overall "blended replacement cost" index was developed in-house by Acres for major projects. It was assumed that labour costs would comprise approximately 65% of total replacement costs, and the remaining 35% would be comprised of various categories of materials and equipment.

TABLE E-2

COMPARISON OF GROSS DOMESTIC PRODUCT IN CURRENT AND CONSTANT DOLLARS, BRITISH COLUMBIA PER CAPITAL GDP COMPARISON, B.C. AND CANADA

	British Columbia Gross Domestic Product				Per Capita G.D.P.		
	Current Dollars	Percent Change	Constant Dollars	Percent Change	British Columbia	Canada	Ratio
	(Millions of Dollars)				(Dollars)		
1961	4,033		5,768		2,476	2,213	1.12
1962	4,310	6.9	6,070	5.2	2,596	2,352	1.10
1963	4,622	7.2	6,428	5.9	2,720	2,473	1.10
1964	5,130	11.0	6,882	7.1	2,940	2,653	1.11
1965	5,758	12.2	7,498	9.0	3,204	2,870	1.12
1966	6,443	11.9	8,053	7.4	3,438	3,146	1.09
1967	7,050	9.4	8,483	5.3	3,625	3,321	1.09
1968	7,715	9.4	8,909	5.0	3,852	3,567	1.08
1969	8,753	13.5	9,611	7.9	4,249	3,860	1.10
1970	9,285	6.1	9,841	2.4	4,363	4,088	1.07
1971	10,426	12.3	10,426	5.9	4,772	4,453	1.07
1972	11,865	13.8	11,169	7.1	5,295	4,898	1.08
1973	14,536	22.5	12,373	10.8	6,315	5,688	1.11
1974	17,323	19.2	13,003	5.1	7,291	6,702	1.09
1975	19,130	10.4	12,686	-2.4	7,863	7,402	1.06
1976	22,534	17.8	13,626	7.4	9,134	8,453	1.08
1977	25,147	11.6	14,156	3.9	10,083	9,176	1.10
1978	27,950	11.1	14,662	3.6	11,047	10,066	1.10
1979	32,433	16.0	15,436	5.3	12,615	11,371	1.11
1980 (1)	36,352	12.1	16,242	5.2	13,770	12,448	1.11

(1) 1980 data is preliminary only and subject to revision.

Source: Ministry of Industry and Small Business Development, Central Statistics Bureau. British Columbia Economic Accounts, 1961 - 1980. May, 1982.

APPENDIX F - COMPUTER RESULTS FOR THE THREE ECONOMIC GROWTH SCENARIOS

APPENDIX F-1
LOW ECONOMIC GROWTH SCENARIO

```
                                   KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                   ******************************************
     PROJECT: EUROCAN
     ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
-----------------------------------------

     CONSTRAINT/                                PROBABILITY     PROBABILITY OF
     REQUIREMENT                                OF SUCCESS      PROJECT GO AHEAD
     -----------                                ----------      ----------------
(1)  COST OF CAPITAL                             .7                 0.46
(2)  TECHNOLOGY                                  .9
(3)  MARKET SIZE                                 .85
(4)  INFLATION                                   .85
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
-----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------       1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead) ---------------------------------------------------------------------
                               0.04   0.08   0.08   0.11   0.13   0.14   0.16   0.18   0.06   0.02

                        1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                        ---------------------------------------------------------------------------
                        0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
--------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------               1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                               ---------------------------------------------------------------------
                               0.02   0.04   0.04   0.05   0.06   0.06   0.07   0.08   0.03   0.01

                        1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                        ---------------------------------------------------------------------------
                        0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
                         KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                         ******************************************
     PROJECT: ALCAN ALUMINUM SMELTER
     ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

     CONSTRAINT/                        PROBABILITY     PROBABILITY OF
     REQUIREMENT                        OF SUCCESS      PROJECT GO AHEAD
     -----------                        -----------     ----------------

(1)  APPROVAL OF KEMANO COMPLETION      .5                   0.19
(2)  MARKET SIZE                        .7
(3)  AVAILABLE POPULATION               .95
(4)  INFRASTRUCTURAL REQUIREMENTS       .95
(5)  FINANCING                          .6


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION               1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
------------------------            ----------------------------------------------------------------------
(assuming project go ahead)            0.00   0.01   0.03   0.03   0.05   0.06   0.06   0.07   0.07   0.08

                                1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                             -----------------------------------------------------------------------------
                                0.08   0.08   0.07   0.07   0.06   0.05   0.04   0.03   0.03   0.02   0.01


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                       1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
----------------                    ----------------------------------------------------------------------
                                       0.00   0.00   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.02

                                1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                             -----------------------------------------------------------------------------
                                0.02   0.02   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.00   0.00
```

```
                                  KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                  ******************************************
      PROJECT: CANADA LIQUID AIR
      ECONOMIC GROWTH SCENARIO: . LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

      CONSTRAINT/                         PROBABILTY        PROBABILITY OF
      REQUIREMENT                         OF SUCCESS        PROJECT GO AHEAD
      -----------                         ----------        ----------------
(1)   MARKET SIZE                           .6                  0.14
(2)   MARKET PRICE                          .5
(3)   TECHNOLOGY                            .5
(4)   LAND AVAILABILITY                     .9
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION                 1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
------------------------           ----------------------------------------------------------------------
(assuming project go ahead)              0.00   0.01   0.01   0.02   0.02   0.03   0.03   0.03   0.03   0.03

                                  1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                               ----------------------------------------------------------------------------
                                  0.06   0.06   0.07   0.08   0.09   0.11   0.09   0.08   0.06   0.05   0.04


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                         1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
----------------                   ----------------------------------------------------------------------
                                         0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

                                  1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                               ----------------------------------------------------------------------------
                                  0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01   0.01
```

```
                         KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                         ******************************************
        PROJECT: OCELOT INDUSTRIES

        ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
--------------------------------------------

        CONSTRAINT/                          PROBABILITY      PROBABILITY OF
        REQUIREMENT                          OF SUCCESS       PROJECT GO AHEAD
        -----------                          -----------      ----------------

(1)     MARKET PRICE                         .9                    0.32
(2)     MARKET SIZE                          .9
(3)     MARKET STABILITY                     .7
(4)     COST OF CAPITAL                      .7
(5)     INFRASTRUCTURE                       .8


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION          1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------    ----------------------------------------------------------------------------------
(assuming project go ahead)       0.05    0.07    0.08    0.10    0.11    0.12    0.13    0.12    0.11    0.07

                          1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                      ------------------------------------------------------------------------------------------
                          0.03    0.01    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                  1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
----------------            ----------------------------------------------------------------------------------
                                  0.02    0.02    0.03    0.03    0.03    0.04    0.04    0.04    0.03    0.02

                          1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                      ------------------------------------------------------------------------------------------
                          0.01    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

```
                                  KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                  ******************************************
        PROJECT: PETRO-CAN RIM GAS

        ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

        CONSTRAINT/                         PROBABILITY      PROBABILITY OF
        REQUIREMENT                         OF SUCCESS       PROJECT GO AHEAD
        -----------                         -----------      ----------------
(1)     MARKET SIZE                         .6                   0.18
(2)     MARKET PRICE                        .6
(3)     TECHNOLOGY                          .5
(4)
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION                1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
------------------------            ----------------------------------------------------------------------
(assuming project go ahead)             0.00   0.00   0.03   0.05   0.11   0.16   0.32   0.25   0.08   0.00

                                 1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                              -----------------------------------------------------------------------------
                                 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                        1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
----------------                    ----------------------------------------------------------------------
                                        0.00   0.00   0.01   0.01   0.02   0.03   0.06   0.05   0.01   0.00

                                 1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                              -----------------------------------------------------------------------------
                                 0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
                         KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                         ******************************************
     PROJECT: CHIEFTAIN DEVELOPMENT CO.

     ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

     CONSTRAINT/                            PROBABILTY        PROBABILITY OF
     REQUIREMENT                            OF SUCCESS        PROJECT GO AHEAD
     -----------                            ----------        ----------------

(1)  MARKET SIZE                              .6                   0.15
(2)  MARKET PRICE                             .5
(3)  TECHNOLOGY                               .5
(4)  ENVIRONMENTAL CONSTRAINTS                1
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION              1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------          ------------------------------------------------------------------------------
(assuming project go ahead)           0.02    0.04    0.06    0.09    0.11    0.15    0.19    0.15    0.10    0.07

                              1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                          --------------------------------------------------------------------------------------
                              0.02    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                      1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
----------------                  ------------------------------------------------------------------------------
                                      0.00    0.01    0.01    0.01    0.02    0.02    0.03    0.02    0.02    0.01

                              1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                          --------------------------------------------------------------------------------------
                              0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

```
                               KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                               ******************************************
      PROJECT: KITIMAT OIL PIPELINE
      ECONOMIC GROWTH SCENARIO:  LOW

  MODEL PHASE ONE:  GO/NO GO PROBABILITIES
  ----------------------------------------

      CONSTRAINT/                          PROBABILITY      PROBABILITY OF
      REQUIREMENT                          OF SUCCESS       PROJECT GO AHEAD
      -----------                          -----------      ----------------
  (1) MARKET PRICE                         .15                  0.01
  (2) SOURCE OF RAW MAT'LS                 .35
  (3) ENVIRONMENTAL CONSIDERATIONS         1
  (4) MARKET SIZE                          .25
  (5) COST OF CAPITAL                      .6


  MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
  ----------------------------------------------

  BLENDED TIMING
  PROBABILITY DISTRIBUTION
  ------------------------     1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
  (assuming project go ahead) -----------------------------------------------------------------------
                               0.00   0.00   0.00   0.00   0.00   0.01   0.01   0.02   0.04   0.06

                        1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                       ------------------------------------------------------------------------------
                        0.07   0.08   0.08   0.08   0.09   0.09   0.09   0.08   0.07   0.07   0.06


  MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
  -------------------------------------------------

  PROBABILITY OF
  START UP BY YEAR
  ----------------             1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                              -----------------------------------------------------------------------
                               0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

                        1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                       ------------------------------------------------------------------------------
                        0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: STEEL MILL (M.I.S.B.)

ECONOMIC GROWTH SCENARIO: LOW

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET SIZE	.4	0.08
(2)	MARKET PRICE	.4	
(3)	SOURCE OF RAW MAT'LS	.75	
(4)	TRANSPORTATION	.75	
(5)	LABOUR COSTS	.9	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION
(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.05	0.06

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.07	0.08	0.09	0.09	0.09	0.08	0.06	0.06	0.05	0.03	0.00

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: LEAD/ZINC SMELTER (M.I.S.R.)

ECONOMIC GROWTH SCENARIO: LOW

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET PRICE	.25	0.01
(2)	MARKET SIZE	.25	
(3)	COST OF POWER	.5	
(4)	SOURCE OF RAW MAT'LS	.25	
(5)	ENVIRONMENTAL CONSIDERATIONS	1	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION
(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.02	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.08

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.01

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
                          KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                          ******************************************
      PROJECT:  ALBERTA GOVERNMENT
      ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

      CONSTRAINT/                            PROBABILTY       PROBABILITY OF
      REQUIREMENT                            OF SUCCESS       PROJECT GO AHEAD
      -----------                            ----------       ----------------
(1)   MARKET SIZE                            .6                   0.15
(2)   MARKET PRICE                           .6
(3)   COST OF CAPITAL                        .6
(4)   COST OF LABOUR                         .95
(5)   SOURCE OF RAW MAT`LS                   .75


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION          1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------    ------------------------------------------------------------------------------------
(assuming project go ahead)       0.00    0.00    0.00    0.00    0.00    0.00    0.01    0.02    0.02    0.03

                          1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                    --------------------------------------------------------------------------------------------
                          0.04    0.05    0.07    0.08    0.09    0.11    0.11    0.10    0.10    0.09    0.08


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                  1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
----------------            ------------------------------------------------------------------------------------
                                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

                          1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                    --------------------------------------------------------------------------------------------
                          0.01    0.01    0.01    0.01    0.01    0.02    0.02    0.02    0.02    0.01    0.01
```

```
                               KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                               ******************************************
      PROJECT: COPPER SMELTER (M.I.S.E.)
      ECONOMIC GROWTH SCENARIO:  LOW

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
---------------------------------------

      CONSTRAINT/                        PROBABILITY      PROBABILITY OF
      REQUIREMENT                        OF SUCCESS       PROJECT GO AHEAD
      -----------                        ----------       ----------------
(1)   MARKET PRICE                       .25
(2)   JAPANESE TARIFF SYSTEM             .4                   0.01
(3)   MARKET SIZE                        .25
(4)   SOURCE OF RAW MAT'S                .25
(5)   ENVIRONMENTAL CONSIDERATIIONS      1


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------        1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead)  ----------------------------------------------------------------------
                                0.00   0.00   0.00   0.01   0.01   0.02   0.03   0.04   0.04   0.05

                         1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                      -----------------------------------------------------------------------------
                         0.06   0.07   0.08   0.09   0.10   0.09   0.09   0.07   0.06   0.05   0.04


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------
                                1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                             ----------------------------------------------------------------------
                                0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00

                         1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                      -----------------------------------------------------------------------------
                         0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

APPENDIX F-2
MEDIUM ECONOMIC GROWTH SCENARIO

```
                                       KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                       ******************************************
        PROJECT: EUROCAN

        ECONOMIC GROWTH SCENARIO:  MEDIUM

  MODEL PHASE ONE:  GO/NO GO PROBABILITIES
  ----------------------------------------


        CONSTRAINT/                           PROBABILITY       PROBABILITY OF
        REQUIREMENT                           OF SUCCESS        PROJECT GO AHEAD
        -----------                           -----------       ----------------
  (1)   COST OF CAPITAL                         .75                   0.61
  (2)   TECHNOLOGY                              .95
  (3)   MARKET SIZE                             .9
  (4)   INFLATION                               .95
  (5)


  MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
  ----------------------------------------------

  BLENDED TIMING
  PROBABILITY DISTRIBUTION
  ------------------------             1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
  (assuming project go ahead)      ------------------------------------------------------------------------------
                                       0.11    0.14    0.11    0.10    0.10    0.09    0.09    0.09    0.09    0.08

                               1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                           --------------------------------------------------------------------------------------
                               0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


  MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
  -------------------------------------------------

  PROBABILITY OF
  START UP BY YEAR
  ----------------                     1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
                                   ------------------------------------------------------------------------------
                                       0.07    0.09    0.07    0.06    0.06    0.05    0.05    0.05    0.05    0.05

                               1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                           --------------------------------------------------------------------------------------
                               0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: ALCAN ALUMINUM SMELTER

ECONOMIC GROWTH SCENARIO: MEDIUM

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	APPROVAL OF KEMANO COMPLETION	.5	0.33
(2)	MARKET SIZE	1	
(3)	AVAILABLE POPULATION	1	
(4)	INFRASTRUCTURAL REQUIREMENTS	.95	
(5)	FINANCING	.7	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION

(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.02	0.04	0.05	0.05	0.05	0.06	0.07	0.07	0.08	0.08

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.00

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00

```
                                    KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                    ******************************************
      PROJECT: CANADA LIQUID AIR

      ECONOMIC GROWTH SCENARIO:  MEDIUM

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

      CONSTRAINT/
      REQUIREMENT                          PROBABILTY        PROBABILITY OF
      -----------                          OF SUCCESS        PROJECT GO AHEAD
                                           ----------        ----------------
(1)   MARKET SIZE                          .85                    0.49
(2)   MARKET PRICE                         .85
(3)   TECHNOLOGY                           .75
(4)   LAND AVAILABILITY                    .9
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------
(assuming project go ahead)         1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                              -------------------------------------------------------------------------
                                    0.00   0.01   0.02   0.03   0.04   0.05   0.06   0.07   0.08   0.09

                             1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         --------------------------------------------------------------------------------
                             0.10   0.09   0.08   0.07   0.06   0.05   0.04   0.03   0.02   0.01   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------                    1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                              -------------------------------------------------------------------------
                                    0.00   0.00   0.01   0.01   0.02   0.02   0.03   0.03   0.04   0.04

                             1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         --------------------------------------------------------------------------------
                             0.05   0.04   0.04   0.03   0.03   0.02   0.02   0.01   0.01   0.00   0.00
```

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT: OCELOT INDUSTRIES

      ECONOMIC GROWTH SCENARIO:  MEDIUM

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
------------------------------------------

      CONSTRAINT/                            PROBABILITY       PROBABILITY OF
      REQUIREMENT                            OF SUCCESS        PROJECT GO AHEAD
      -----------                            ----------        ----------------
(1)   MARKET PRICE                           1
(2)   MARKET SIZE                            1                      0.61
(3)   MARKET STABILITY                       .85
(4)   COST OF CAPITAL                        .8
(5)   INFRASTRUCTURE                         .9


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
------------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------              1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead)     ----------------------------------------------------------------------
                                      0.06   0.09   0.11   0.12   0.12   0.12   0.12   0.11   0.09   0.06

                               1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          ----------------------------------------------------------------------------
                               0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
--------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------                      1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                                ----------------------------------------------------------------------
                                      0.04   0.06   0.07   0.07   0.07   0.07   0.07   0.07   0.06   0.04

                               1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          ----------------------------------------------------------------------------
                               0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
                                       KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                       ******************************************
          PROJECT: PETRO-CAN RIM GAS

          ECONOMIC GROWTH SCENARIO:  MEDIUM

    MODEL PHASE ONE:  GO/NO GO PROBABILITIES
    ----------------------------------------


          CONSTRAINT/                          PROBABILITY       PROBABILITY OF
          REQUIREMENT                          OF SUCCESS        PROJECT GO AHEAD
          -----------                          ----------        ----------------

    (1)   MARKET SIZE                          .9                     0.69
    (2)   MARKET PRICE                         .9
    (3)   TECHNOLOGY                           .85
    (4)
    (5)



    MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
    ----------------------------------------------


    BLENDED TIMING
    PROBABILITY DISTRIBUTION            1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
    ------------------------        --------------------------------------------------------------------------------
    (assuming project go ahead)         0.00    0.02    0.04    0.10    0.19    0.24    0.19    0.15    0.07    0.00

                                1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                            ------------------------------------------------------------------------------------------
                                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00



    MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
    -------------------------------------------------


    PROBABILITY OF
    START UP BY YEAR                    1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
    ----------------                --------------------------------------------------------------------------------
                                        0.00    0.01    0.03    0.07    0.13    0.17    0.13    0.10    0.05    0.00

                                1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                            ------------------------------------------------------------------------------------------
                                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT: KITIMAT OIL PIPELINE

      ECONOMIC GROWTH SCENARIO:  MEDIUM

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------


      CONSTRAINT/                      PROBABILITY       PROBABILITY OF
      REQUIREMENT                      OF SUCCESS        PROJECT GO AHEAD
      -----------                      -----------       ----------------

(1)   MARKET PRICE                     .7                    0.08
(2)   SOURCE OF RAW MAT'LS             .4
(3)   ENVIRONMENTAL CONCERNS           .9
(4)   MARKET SIZE                      .5
(5)   COST OF CAPITAL                  .6



MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------


BLENDED TIMING
PROBABILITY DISTRIBUTION               1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------          ------------------------------------------------------------------------------
(assuming project go ahead)            0.00    0.00    0.00    0.00    0.01    0.02    0.03    0.04    0.04    0.06


                               1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                          --------------------------------------------------------------------------------------
                               0.06    0.07    0.08    0.08    0.09    0.08    0.08    0.08    0.07    0.06    0.05



MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------


PROBABILITY OF
START UP BY YEAR                       1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
----------------                  ------------------------------------------------------------------------------
                                       0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


                               1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                          --------------------------------------------------------------------------------------
                               0.00    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.00    0.00
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
      PROJECT: CHIEFTAIN DEVELOPMENT CO.
      ECONOMIC GROWTH SCENARIO:  MEDIUM

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
---------------------------------------

      CONSTRAINT/                               PROBABILTY        PROBABILITY OF
      REQUIREMENT                               OF SUCCESS        PROJECT GO AHEAD
      -----------                               ----------        ----------------
(1)   MARKET SIZE                                .9                   0.62
(2)   MARKET PRICE                               .9
(3)   TECHNOLOGY                                 .85
(4)   ENVIRONMENTAL CONSTRAINTS                  .9
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------
(assuming project go ahead)          1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
                               ---------------------------------------------------------------------------------
                                     0.08    0.11    0.13    0.16    0.15    0.13    0.12    0.08    0.04    0.00

                            1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                       -----------------------------------------------------------------------------------------
                            0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------
                                     1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
                               ---------------------------------------------------------------------------------
                                     0.05    0.07    0.08    0.10    0.09    0.08    0.07    0.05    0.02    0.00

                            1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                       -----------------------------------------------------------------------------------------
                            0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: LEAD/ZINC SMELTER (M.I.S.B.)

ECONOMIC GROWTH SCENARIO: MEDIUM

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET PRICE	.8	0.30
(2)	MARKET SIZE	.75	
(3)	COST OF POWER	.8	
(4)	SOURCE OF RAW MAT'LS	.7	
(5)	ENVIRONMENTAL CONSIDERATIONS	.9	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION

(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.01	0.05	0.05	0.06	0.07	0.07	0.07	0.07	0.07	0.07

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.07	0.06	0.06	0.05	0.05	0.04	0.03	0.02	0.02	0.01	0.00

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00

```
                                   KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                   ******************************************
        PROJECT: STEEL MILL (M.I.S.B.)
        ECONOMIC GROWTH SCENARIO:  MEDIUM

    MODEL PHASE ONE:  GO/NO GO PROBABILITIES
    ----------------------------------------

        CONSTRAINT/                        PROBABILITY         PROBABILITY OF
        REQUIREMENT                        OF SUCCESS          PROJECT GO AHEAD
        -----------                        -----------         ----------------
    (1) MARKET SIZE                           .8                    0.41
    (2) MARKET PRICE                          .8
    (3) SOURCE OF RAW MAT'LS                  .9
    (4) TRANSPORTATION                        .9
    (5) LABOUR COSTS                          .8


    MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
    ----------------------------------------------

    BLENDED TIMING
    PROBABILITY DISTRIBUTION
    ------------------------          1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
    (assuming project go ahead)   ------------------------------------------------------------------------
                                      0.00   0.01   0.03   0.03   0.04   0.05   0.06   0.06   0.07   0.07

                               1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                               -----------------------------------------------------------------------------
                               0.08   0.08   0.08   0.08   0.07   0.06   0.05   0.04   0.03   0.01   0.00


    MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
    -------------------------------------------------

    PROBABILITY OF
    START UP BY YEAR
    ----------------                  1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                                  ------------------------------------------------------------------------
                                      0.00   0.00   0.01   0.01   0.02   0.02   0.02   0.02   0.03   0.03

                               1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                               -----------------------------------------------------------------------------
                               0.03   0.03   0.03   0.03   0.03   0.02   0.02   0.02   0.01   0.00   0.00
```

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT: COPPER SMELTER (M.I.S.B.)
      ECONOMIC GROWTH SCENARIO:  MEDIUM

  MODEL PHASE ONE:  GO/NO GO PROBABILITIES
  ----------------------------------------

      CONSTRAINT/                         PROBABILTY    PROBABILITY OF
      REQUIREMENT                         OF SUCCESS    PROJECT GO AHEAD
      -----------                         ----------    ----------------

 (1)  MARKET PRICE                          .8               0.30
 (2)  JAPANESE TARIFF SYSTEM                .8
 (3)  MARKET SIZE                           .75
 (4)  SOURCE OF RAW MAT'LS                  .7
 (5)  ENVIRONMENTAL CONSIDERATIONS          .9


  MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
  ----------------------------------------------

  BLENDED TIMING
  PROBABILITY DISTRIBUTION              1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
  ------------------------         ---------------------------------------------------------------------
  (assuming project go ahead)           0.00   0.00   0.00   0.00   0.00   0.03   0.08   0.09   0.09   0.09

                                 1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                              ----------------------------------------------------------------------------
                                 0.09   0.09   0.09   0.09   0.07   0.06   0.05   0.04   0.03   0.01   0.00


  MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
  -------------------------------------------------

  PROBABILITY OF
  START UP BY YEAR                      1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
  ----------------                 ---------------------------------------------------------------------
                                        0.00   0.00   0.00   0.00   0.00   0.01   0.02   0.03   0.03   0.03

                                 1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                              ----------------------------------------------------------------------------
                                 0.03   0.03   0.03   0.03   0.02   0.02   0.02   0.01   0.01   0.00   0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: ALBERTA GOVERNMENT

ECONOMIC GROWTH SCENARIO: MEDIUM

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILTY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET SIZE	.9	0.43
(2)	MARKET PRICE	.9	
(3)	COST OF CAPITAL	.7	
(4)	COST OF LABOUR	.9	
(5)	SOURCE OF RAW MAT`LS	.85	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION
(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.04	0.05	0.06

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.07	0.07	0.08	0.09	0.10	0.09	0.09	0.08	0.06	0.05	0.03

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.01

APPENDIX F-3
HIGH ECONOMIC GROWTH SCENARIO

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT: EUROCAN
      ECONOMIC GROWTH SCENARIO:  HIGH
MODEL PHASE ONE:  GO/NO GO PROBABILITIES
--------------------------------------------

      CONSTRAINT/                         PROBABILITY      PROBABILITY OF
      REQUIREMENT                         OF SUCCESS       PROJECT GO AHEAD
      -----------                         -----------      ----------------
(1)   COST OF CAPITAL                      .85                 0.81
(2)   TECHNOLOGY                           1
(3)   MARKET SIZE                          1
(4)   INFLATION                            .95
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
-----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION                1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------          --------------------------------------------------------------------------------
(assuming project go ahead)             0.16    0.16    0.14    0.13    0.11    0.10    0.09    0.07    0.04    0.00

                                1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                              ------------------------------------------------------------------------------------
                                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
--------------------------------------------------

PROBABILITY OF
START UP BY YEAR                        1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
----------------                  --------------------------------------------------------------------------------
                                        0.13    0.13    0.11    0.10    0.09    0.08    0.07    0.06    0.03    0.00

                                1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                              ------------------------------------------------------------------------------------
                                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
         PROJECT: ALCAN ALUMINUM SMELTER

         ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------


         CONSTRAINT/                      PROBABILITY      PROBABILITY OF
         REQUIREMENT                      OF SUCCESS       PROJECT GO AHEAD
         -----------                      ----------       ----------------
(1)      APPROVAL OF KEMANO COMPLETION     .5                   0.40
(2)      MARKET SIZE                       1
(3)      AVAILABLE POPULATION              1
(4)      INFRASTRUCTURAL REQUIREMENTS      1
(5)      FINANCING                         .8



MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION                 1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
------------------------         ------------------------------------------------------------------------------------
(assuming project go ahead)              0.03    0.04    0.05    0.06    0.08    0.10    0.10    0.09    0.08    0.07

                                 1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                              ---------------------------------------------------------------------------------------
                                 0.06    0.05    0.04    0.03    0.03    0.03    0.03    0.02    0.01    0.00    0.00



MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                         1983    1984    1985    1986    1987    1988    1989    1990    1991    1992
--------------                   ------------------------------------------------------------------------------------
                                         0.01    0.02    0.02    0.02    0.03    0.04    0.04    0.04    0.03    0.03

                                 1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                              ---------------------------------------------------------------------------------------
                                 0.02    0.02    0.02    0.01    0.01    0.01    0.01    0.01    0.00    0.00    0.00
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
        PROJECT: CANADA LIQUID AIR
        ECONOMIC GROWTH SCENARIO:  HIGH
MODEL PHASE ONE:  GO/NO GO PROBABILITIES
-----------------------------------------

        CONSTRAINT/                    PROBABILTY       PROBABILITY OF
        REQUIREMENT                    OF SUCCESS       PROJECT GO AHEAD
        -----------                    ----------       ----------------
(1)     MARKET SIZE                      .95                 0.77
(2)     MARKET PRICE                     .95
(3)     TECHNOLOGY                       .95
(4)     LAND AVAILABILITY                .9
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
-----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------            1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead)    ------------------------------------------------------------------------
                                    0.03   0.04   0.06   0.07   0.07   0.08   0.09   0.09   0.08   0.07

                             1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          -------------------------------------------------------------------------------
                             0.06   0.05   0.04   0.04   0.03   0.03   0.02   0.02   0.02   0.01   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
--------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------                    1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                               ------------------------------------------------------------------------
                                    0.02   0.03   0.05   0.05   0.05   0.06   0.07   0.07   0.06   0.05

                             1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          -------------------------------------------------------------------------------
                             0.05   0.04   0.03   0.03   0.02   0.02   0.02   0.02   0.02   0.01   0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: OCELOT INDUSTRIES

ECONOMIC GROWTH SCENARIO: HIGH

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET PRICE	1	0.81
(2)	MARKET SIZE	1	
(3)	MARKET STABILITY	1	
(4)	COST OF CAPITAL	.9	
(5)	INFRASTRUCTURE	.9	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION
(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.12	0.13	0.14	0.15	0.14	0.11	0.09	0.07	0.04	0.01

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.10	0.11	0.11	0.12	0.11	0.09	0.07	0.06	0.03	0.01

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT: PETRO-CAN RIM GAS
      ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

      CONSTRAINT/                           PROBABILITY    PROBABILITY OF
      REQUIREMENT                           OF SUCCESS     PROJECT GO AHEAD
      -----------                           -----------    ----------------
(1)   MARKET SIZE                           1                   0.90
(2)   MARKET PRICE                          1
(3)   TECHNOLOGY                            .9
(4)
(5)


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------          1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead)   -----------------------------------------------------------------------
                                  0.00   0.00   0.01   0.12   0.20   0.21   0.19   0.14   0.08   0.04

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          ---------------------------------------------------------------------------
                           0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------                  1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                              -----------------------------------------------------------------------
                                  0.00   0.00   0.01   0.11   0.18   0.19   0.17   0.13   0.07   0.04

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                          ---------------------------------------------------------------------------
                           0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
                                      KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                                      ******************************************
        PROJECT: KITIMAT OIL PIPELINE

        ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------


        CONSTRAINT/                       PROBABILITY      PROBABILITY OF
        REQUIREMENT                       OF SUCCESS       PROJECT GO AHEAD
        -----------                       ----------       ----------------

(1)     MARKET PRICE                      .75                   0.08
(2)     SOURCE OF RAW MAT'LS              .4
(3)     ENVIRONMENTAL CONCERNS            .8
(4)     MARKET SIZE                       .5
(5)     COST OF CAPITAL                   .7



MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------


BLENDED TIMING
PROBABILITY DISTRIBUTION               1983    1984    1965    1986    1987    1988    1989    1990    1991    1992
------------------------           --------------------------------------------------------------------------------
(assuming project go ahead)            0.00    0.00    0.00    0.01    0.02    0.03    0.04    0.05    0.06    0.06


                                 1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                               ----------------------------------------------------------------------------------------
                                 0.06    0.06    0.08    0.09    0.09    0.08    0.06    0.06    0.06    0.05    0.04



MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------


PROBABILITY OF
START UP BY YEAR                       1983    1984    1965    1986    1987    1988    1989    1990    1991    1992
----------------                   --------------------------------------------------------------------------------
                                       0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.01    0.01


                                 1993    1994    1995    1996    1997    1998    1999    2000    2001    2002    2003
                               ----------------------------------------------------------------------------------------
                                 0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.00    0.00
```

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
     PROJECT: CHIEFTAIN DEVELOPMENT CO.

     ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

     CONSTRAINT/                         PROBABILITY      PROBABILITY OF
     REQUIREMENT                         OF SUCCESS       PROJECT GO AHEAD
     -----------                         ----------       ----------------
(1)  MARKET SIZE                          1                    0.72
(2)  MARKET PRICE                         1
(3)  TECHNOLOGY                           .9
(4)  ENVIRONMENTAL CONSTRAINTS            .8
(5)


MODEL PHASF TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION
------------------------         1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
(assuming project go ahead)     ----------------------------------------------------------------------
                                 0.10   0.14   0.16   0.16   0.14   0.10   0.08   0.06   0.04   0.02

                          1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         ----------------------------------------------------------------------------
                          0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR
----------------                 1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
                                ----------------------------------------------------------------------
                                 0.07   0.10   0.12   0.12   0.10   0.07   0.06   0.04   0.03   0.01

                          1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         ----------------------------------------------------------------------------
                          0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

```
                           KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                           ******************************************
       PROJECT: LEAD/ZINC SMELTER (M.I.S.B.)

       ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

       CONSTRAINT/                     PROBABILITY        PROBABILITY OF
       REQUIREMENT                     OF SUCCESS         PROJECT GO AHEAD
       -----------                     -----------        ----------------
(1)    MARKET PRICE                     1                     0.61
(2)    MARKET SIZE                      1
(3)    COST OF POWER                    .9
(4)    SOURCE OF RAW MAT'LS             .85
(5)    ENVIRONMENTAL CONSIDERATIONS     .8


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION          1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
------------------------        ----------------------------------------------------------------------
(assuming project go ahead)       0.02   0.06   0.06   0.08   0.10   0.08   0.08   0.07   0.07   0.06

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                        -----------------------------------------------------------------------------
                           0.06   0.05   0.05   0.04   0.03   0.03   0.02   0.02   0.01   0.01   0.00


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                  1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
----------------                ----------------------------------------------------------------------
                                  0.01   0.04   0.04   0.05   0.06   0.05   0.05   0.04   0.04   0.04

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                        -----------------------------------------------------------------------------
                           0.04   0.03   0.03   0.02   0.02   0.02   0.01   0.01   0.01   0.01   0.00
```

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: STEEL MILL (M.I.S.B.)

ECONOMIC GROWTH SCENARIO: HIGH

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILTY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET SIZE	1	0.63
(2)	MARKET PRICE	.9	
(3)	SOURCE OF RAW MAT'LS	1	
(4)	TRANSPORTATION	1	
(5)	LABOUR COSTS	.7	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION
(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.01	0.02	0.03	0.05	0.07	0.08	0.09	0.10	0.09

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.08	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.00

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.06

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.00

KITIMAT-TERRACE LAND USE PROBABILITY MODEL

PROJECT: COPPER SMELTER (M.I.S.B.)

ECONOMIC GROWTH SCENARIO: HIGH

MODEL PHASE ONE: GO/NO GO PROBABILITIES

	CONSTRAINT/ REQUIREMENT	PROBABILITY OF SUCCESS	PROBABILITY OF PROJECT GO AHEAD
(1)	MARKET PRICE	1	0.65
(2)	JAPANESE TARIFF SYSTEM	.95	
(3)	MARKET SIZE	1	
(4)	SOURCE OF RAW MAT'S	.85	
(5)	ENVIRONMENTAL CONSIDERATIIONS	.8	

MODEL PHASE TWO: START UP TIMING DISTRIBUTION

BLENDED TIMING PROBABILITY DISTRIBUTION

(assuming project go ahead)

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.02	0.04	0.05	0.07	0.08	0.09	0.08	0.07	0.07

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.07	0.06	0.06	0.05	0.05	0.04	0.04	0.02	0.02	0.01	0.01

MODEL PHASE THREE: ANNUAL START UP PROBABILITIES

PROBABILITY OF START UP BY YEAR

1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0.00	0.01	0.03	0.03	0.05	0.05	0.06	0.05	0.05	0.05

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01

```
                              KITIMAT-TERRACE LAND USE PROBABILITY MODEL
                              ******************************************
      PROJECT:  ALBERTA GOVERNMENT
      ECONOMIC GROWTH SCENARIO:  HIGH

MODEL PHASE ONE:  GO/NO GO PROBABILITIES
----------------------------------------

      CONSTRAINT/                        PROBABILTY     PROBABILITY OF
      REQUIREMENT                        OF SUCCESS     PROJECT GO AHEAD
      -----------                        ----------     ----------------

(1)   MARKET SIZE                        1                   0.65
(2)   MARKET PRICE                       1
(3)   COST OF CAPITAL                    .8
(4)   COST OF LABOUR                     .85
(5)   SOURCE OF RAW MAT`LS               .95


MODEL PHASE TWO:  START UP TIMING DISTRIBUTION
----------------------------------------------

BLENDED TIMING
PROBABILITY DISTRIBUTION          1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
------------------------        ----------------------------------------------------------------------
(assuming project go ahead)       0.00   0.00   0.01   0.02   0.02   0.03   0.04   0.05   0.05   0.06

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         -----------------------------------------------------------------------------
                           0.07   0.07   0.08   0.09   0.08   0.07   0.07   0.06   0.05   0.05   0.03


MODEL PHASE THREE: ANNUAL  START UP PROBABILITIES
-------------------------------------------------

PROBABILITY OF
START UP BY YEAR                  1983   1984   1985   1986   1987   1988   1989   1990   1991   1992
----------------                ----------------------------------------------------------------------
                                  0.00   0.00   0.01   0.01   0.01   0.02   0.03   0.03   0.03   0.04

                           1993   1994   1995   1996   1997   1998   1999   2000   2001   2002   2003
                         -----------------------------------------------------------------------------
                           0.05   0.05   0.05   0.06   0.05   0.05   0.05   0.04   0.03   0.03   0.02
```

POOR

QUALITY

ORIGINAL